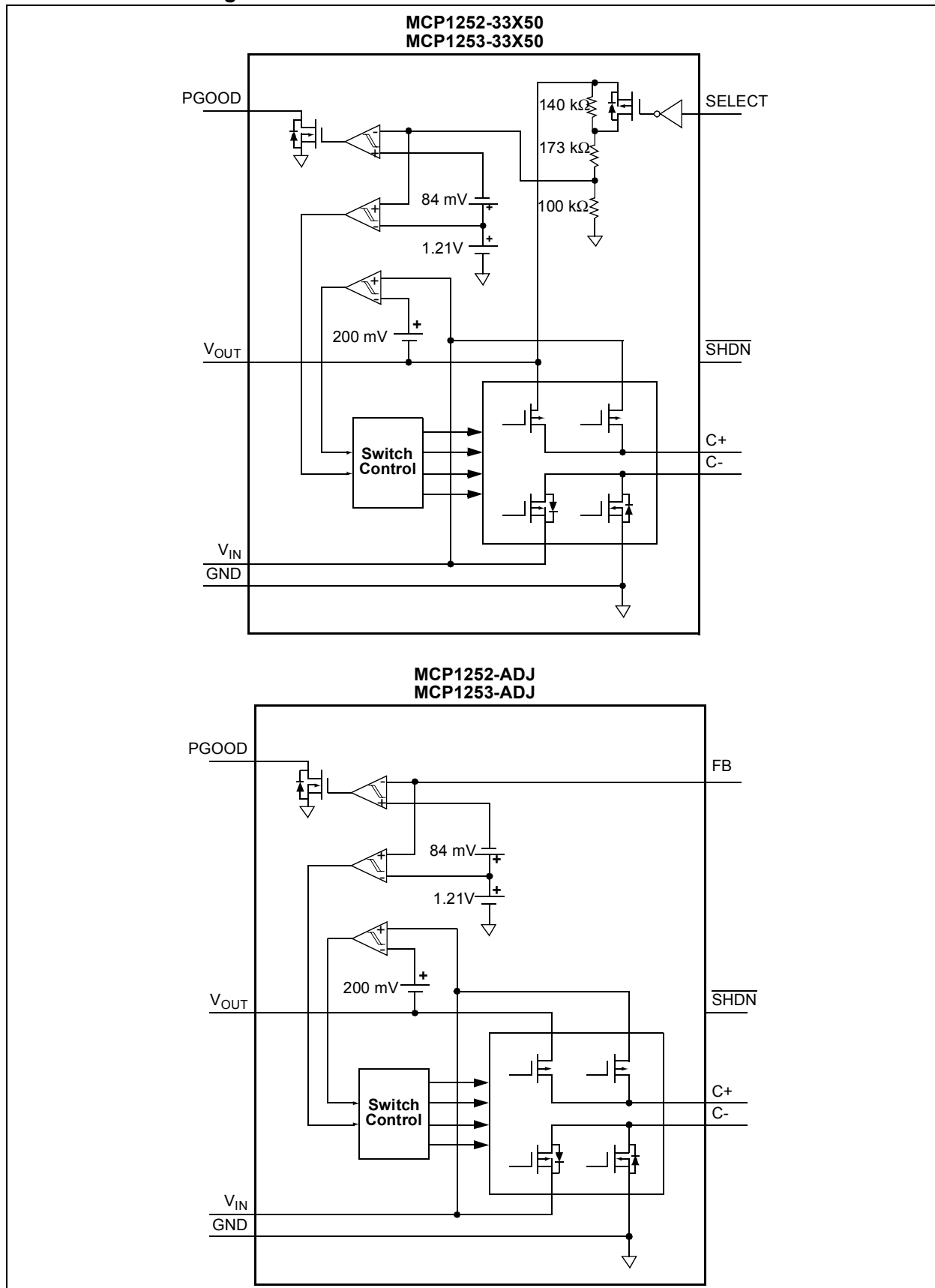


# MCP1252/3

## Functional Block Diagram



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Power Supply Voltage,  $V_{IN}$  ..... 6.0V  
 Voltage on Any Pin w.r.t. GND ..... -0.3V to ( $V_{IN} + 0.3V$ )  
 Output Short Circuit Duration ..... continuous  
 Storage Temperature Range ..... -65°C to +150°C  
 Ambient Temperature with Power Applied ..... -55°C to +125°C  
 Junction Temperature ..... +150°C

#### ESD Ratings:

Human Body Model (1.5 k $\Omega$  in Series with 100 pF) .....  $\geq 4$  kV

Machine Body Model (200 pF, No Series Resistance)  $\geq 400V$

†**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.

## PIN FUNCTION TABLE

| Name      | Function                                                               |
|-----------|------------------------------------------------------------------------|
| PGOOD     | Open-Drain Power GOOD Output                                           |
| $V_{OUT}$ | Regulated Output Voltage                                               |
| $V_{IN}$  | Power Supply Input                                                     |
| GND       | Ground Terminal                                                        |
| C-        | Flying Capacitor Negative Terminal                                     |
| C+        | Flying Capacitor Positive Terminal                                     |
| SHDN      | Shutdown Mode, Active-Low Input                                        |
| SELECT    | Output Voltage Select Pin.<br>(MCP1252-33X50, MCP1253-33X50)           |
| FB        | Feedback Input Pin for Adjustable Output<br>(MCP1252-ADJ, MCP1253-ADJ) |

## ELECTRICAL CHARACTERISTICS

**Electrical Specifications:** Unless otherwise specified, all limits are specified for  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $\overline{\text{SHDN}} = V_{IN}$ ,  $C_{IN} = C_{OUT} = 10 \mu\text{F}$ ,  $C_{FLY} = 1 \mu\text{F}$ ,  $I_{OUT} = 10 \text{ mA}$ . Typical values are for  $T_A = +25^\circ\text{C}$ .

| Parameters                                                                                                         | Sym        | Min       | Typ           | Max  | Units         | Conditions                                                                                                               |
|--------------------------------------------------------------------------------------------------------------------|------------|-----------|---------------|------|---------------|--------------------------------------------------------------------------------------------------------------------------|
| <b>Selectable Output - MCP1252-33X50, MCP1253-33X50: SELECT = <math>V_{IN}</math>, <math>V_{OUT} = 3.3V</math></b> |            |           |               |      |               |                                                                                                                          |
| Supply Voltage                                                                                                     | $V_{IN}$   | 2.1       | —             | 5.5  | V             |                                                                                                                          |
| Output Voltage Accuracy                                                                                            | $V_{OUT}$  | -2.5      | +/-0.5        | +2.5 | %             | $2.3V \leq V_{IN} < 2.5V$ , $I_{OUT} \leq 80 \text{ mA}$<br>$2.5V \leq V_{IN} \leq 5.5V$ , $I_{OUT} \leq 120 \text{ mA}$ |
| Output Current                                                                                                     | $I_{OUT}$  | 80<br>120 | 100<br>150    | —    | mA<br>mA      | $2.3V \leq V_{IN} < 2.5V$<br>$2.5V \leq V_{IN} \leq 5.5V$                                                                |
| SELECT Logic Input Voltage High                                                                                    | $V_{IH}$   | 1.4       | —             | —    | V             | MCP1252-33X50, MCP1253-33X50                                                                                             |
| <b>Selectable Output - MCP1252-33X50, MCP1253-33X50: SELECT = GND, <math>V_{OUT} = 5.0V</math></b>                 |            |           |               |      |               |                                                                                                                          |
| Supply Voltage                                                                                                     | $V_{IN}$   | 2.7       | —             | 5.5  | V             |                                                                                                                          |
| Output Voltage Accuracy                                                                                            | $V_{OUT}$  | -2.5      | +/-0.5        | +2.5 | %             | $2.7V \leq V_{IN} < 3.0V$ , $I_{OUT} \leq 40 \text{ mA}$<br>$3.0V \leq V_{IN} \leq 5.5V$ , $I_{OUT} \leq 120 \text{ mA}$ |
| Output Current                                                                                                     | $I_{OUT}$  | 40<br>120 | 80<br>150     | —    | mA<br>mA      | $2.7V \leq V_{IN} < 3.0V$<br>$3.0V \leq V_{IN} \leq 5.5V$                                                                |
| SELECT Logic Input Voltage Low                                                                                     | $V_{IL}$   | —         | —             | 0.4  | V             | MCP1252-33X50, MCP1253-33X50                                                                                             |
| <b>Adjustable Output - MCP1252-ADJ, MCP1253-ADJ</b>                                                                |            |           |               |      |               |                                                                                                                          |
| Supply Voltage                                                                                                     | $V_{IN}$   | 2.0       | —             | 5.5  | V             |                                                                                                                          |
| Output Voltage Adjustment Range                                                                                    | $V_{OUT}$  | 1.5       | —             | 5.5  | V             | $V_{OUT(MAX)} < 2 \times V_{IN}$                                                                                         |
| FB Regulation Voltage                                                                                              | $V_{FB}$   | 1.18      | 1.21          | 1.24 | V             | MCP1252-ADJ, MCP1253-ADJ                                                                                                 |
| <b>ALL DEVICES</b>                                                                                                 |            |           |               |      |               |                                                                                                                          |
| Supply Current                                                                                                     | $I_{DD}$   | —         | 60            | 120  | $\mu\text{A}$ | No load                                                                                                                  |
| Output Short-Circuit Current                                                                                       | $I_{SC}$   | —         | 200           | —    | mA            | $V_{OUT} = \text{GND}$ , foldback current                                                                                |
| Shutdown Current                                                                                                   | $I_{SHDN}$ | —         | 0.1           | 2.0  | $\mu\text{A}$ | $\overline{\text{SHDN}} = 0V$                                                                                            |
| Power Efficiency                                                                                                   | $\eta$     | —         | 81<br>68      | —    | %<br>%        | $V_{IN} = 3.0V$ , $V_{OUT} = 5V$<br>$V_{IN} = 3.6V$ , $V_{OUT} = 5V$<br>$I_{OUT} = 120 \text{ mA}$                       |
| SHDN Logic Input Voltage Low                                                                                       | $V_{IL}$   | —         | —             | 0.4  | V             |                                                                                                                          |
| SHDN Logic Input Voltage High                                                                                      | $V_{IH}$   | 1.4       | —             | —    | V             |                                                                                                                          |
| PGOOD Threshold Voltage                                                                                            | $V_{TH}$   | —         | $0.93V_{OUT}$ | —    | V             |                                                                                                                          |
| PGOOD Hysteresis                                                                                                   | $V_{HYS}$  | —         | $0.04V_{OUT}$ | —    | V             |                                                                                                                          |

# MCP1252/3

## AC CHARACTERISTICS

**Electrical Specifications:** Unless otherwise specified, all limits are specified for  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{IN} = 2.7\text{V}$  to  $5.5\text{V}$ ,  $\text{SELECT} = \text{GND}$ ,  $\text{SHDN} = V_{IN}$ ,  $C_{IN} = C_{OUT} = 10\ \mu\text{F}$ ,  $C_{FLY} = 1\ \mu\text{F}$ ,  $I_{OUT} = 10\ \text{mA}$ . Typical values are for  $T_A = +25^{\circ}\text{C}$ .

| Parameters                           | Sym        | Min        | Typ         | Max         | Units                                  | Conditions                                                                                                                                                                                                       |
|--------------------------------------|------------|------------|-------------|-------------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Internal Oscillator Frequency        | $F_{OSC}$  | 520<br>800 | 650<br>1000 | 780<br>1200 | kHz<br>kHz                             | MCP1252<br>MCP1253                                                                                                                                                                                               |
| Ripple Voltage                       | $V_{RIP}$  | —          | 50<br>45    | —           | $\text{mV}_{p-p}$<br>$\text{mV}_{p-p}$ | MCP1252<br>MCP1253                                                                                                                                                                                               |
| $V_{OUT}$ Wake-Up Time From Shutdown | $T_{WKUP}$ | —          | 200<br>300  | —           | $\mu\text{sec}$<br>$\mu\text{sec}$     | $\text{SELECT} = V_{IN}$<br>$\text{SELECT} = \text{GND}$<br>$V_{IN} = 3.6\text{V}$ , $I_{OUT} = 10\ \text{mA}$ ,<br>$\text{SHDN} = V_{IH(MIN)}$ ,<br>$V_{OUT}$ from 0 to 90% Nominal<br>Regulated Output Voltage |

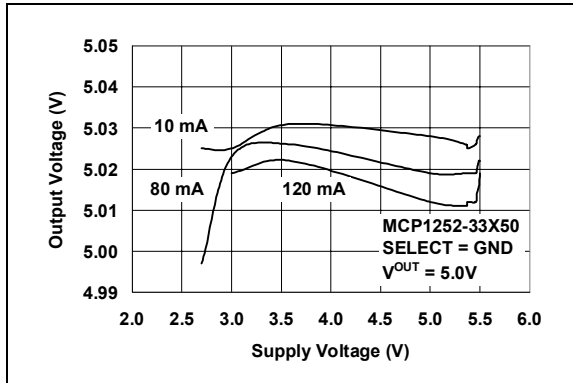
## TEMPERATURE SPECIFICATIONS

| Parameters                             | Symbol        | Min | Typ | Max  | Units                | Conditions                                         |
|----------------------------------------|---------------|-----|-----|------|----------------------|----------------------------------------------------|
| <b>Temperature Ranges:</b>             |               |     |     |      |                      |                                                    |
| Specified Temperature Range            | $T_A$         | -40 | —   | +85  | $^{\circ}\text{C}$   |                                                    |
| Maximum Operating Junction Temperature | $T_J$         | —   | —   | +125 | $^{\circ}\text{C}$   |                                                    |
| Storage Temperature Range              | $T_A$         | -65 | —   | +150 | $^{\circ}\text{C}$   |                                                    |
| <b>Thermal Package Resistances:</b>    |               |     |     |      |                      |                                                    |
| Thermal Resistance, 8 Pin MSOP         | $\theta_{JA}$ | —   | 206 | —    | $^{\circ}\text{C/W}$ | Single-Layer SEMI G42-88 Board, Natural Convection |

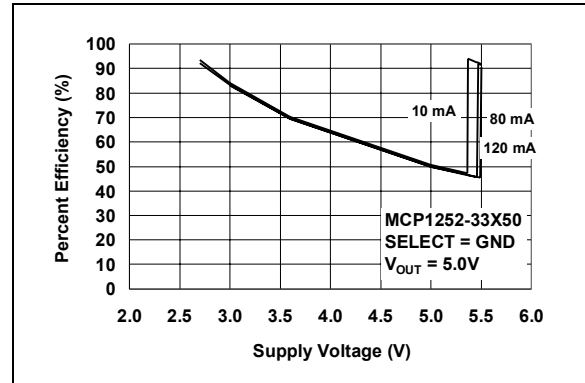
## 2.0 TYPICAL PERFORMANCE CURVES

**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.

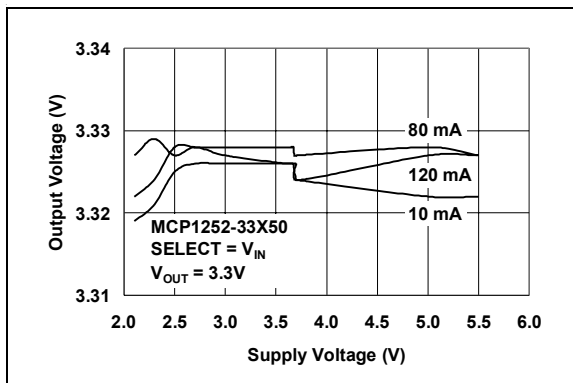
**Note:** Unless otherwise indicated,  $V_{IN} = 3.6V$ ,  $T_A = 25^\circ C$ ,  $C_{IN} = C_{OUT} = 10 \mu F$ ,  $C_{FLY} = 1 \mu F$ , all capacitors X7R ceramic.



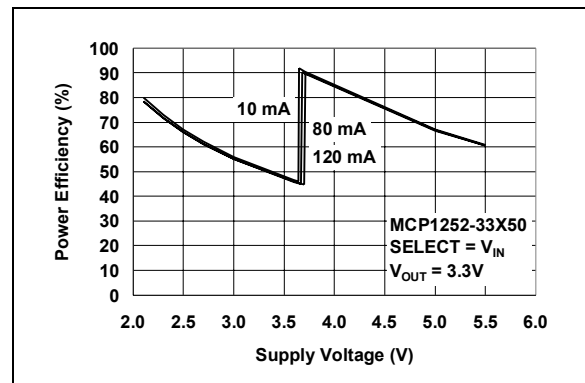
**FIGURE 2-1:** Output Voltage vs. Supply Voltage (MCP1252-33X50).



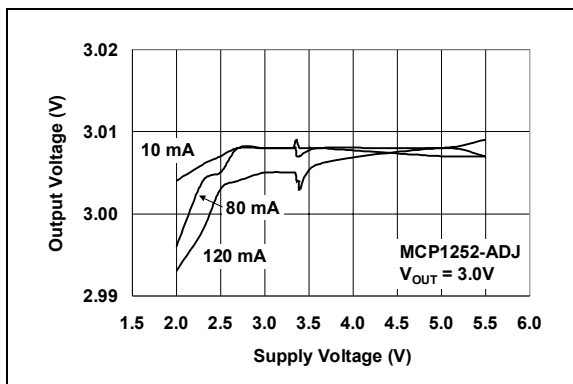
**FIGURE 2-4:** Percent Efficiency vs. Supply Voltage (MCP1252-33X50).



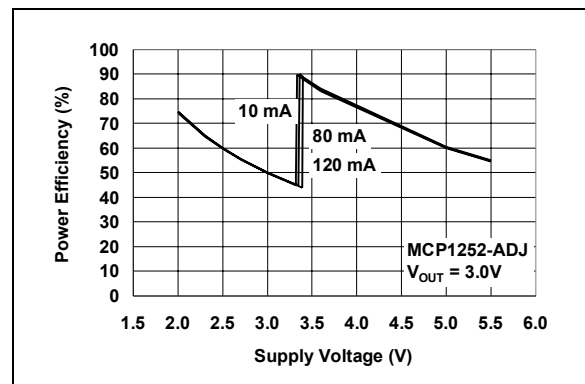
**FIGURE 2-2:** Output Voltage vs. Supply Voltage (MCP1252-33X50).



**FIGURE 2-5:** Power Efficiency vs. Supply Voltage (MCP1252-33X50).



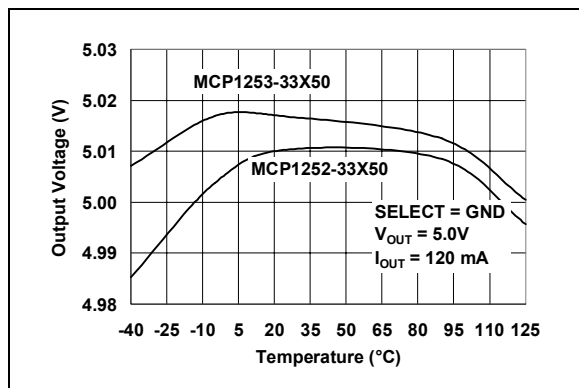
**FIGURE 2-3:** Output Voltage vs. Supply Voltage (MCP1252-ADJ).



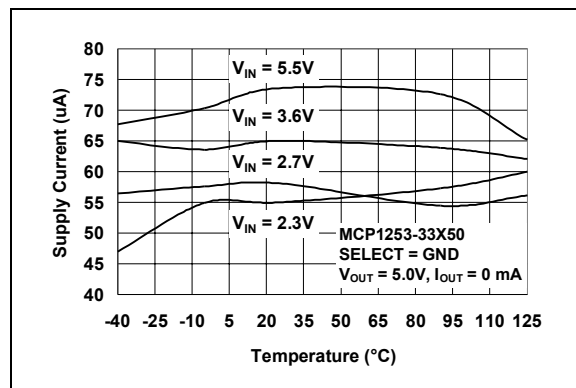
**FIGURE 2-6:** Power Efficiency vs. Supply Voltage (MCP1252-ADJ).

# MCP1252/3

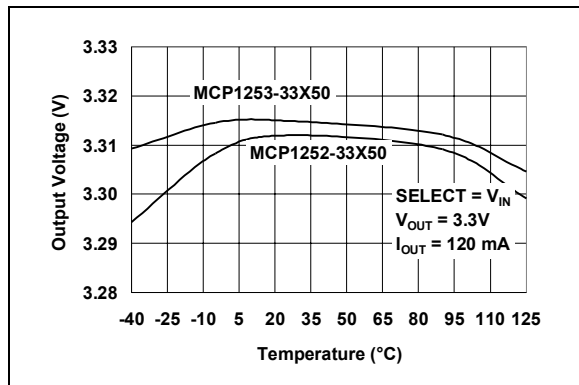
**Note:** Unless otherwise indicated,  $V_{IN} = 3.6V$ ,  $T_A = 25^\circ C$ ,  $C_{IN} = C_{OUT} = 10\text{ mF}$ ,  $C_{FLY} = 1\text{ mF}$ , all capacitors X7R ceramic.



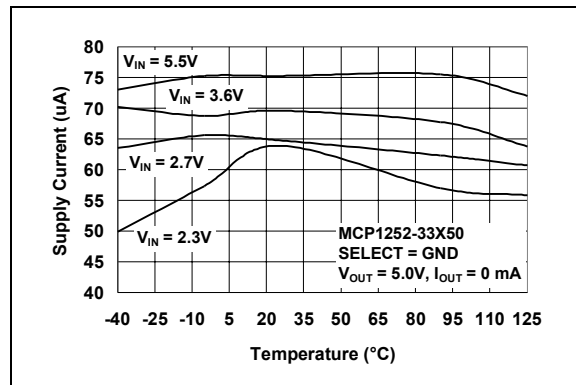
**FIGURE 2-7:** Output Voltage vs. Temperature (MCP1252-33X50, MCP1253-33X50).



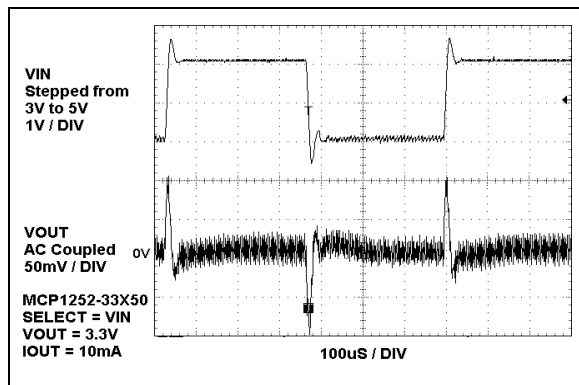
**FIGURE 2-10:** Quiescent Current vs. Temperature (MCP1253-33X50).



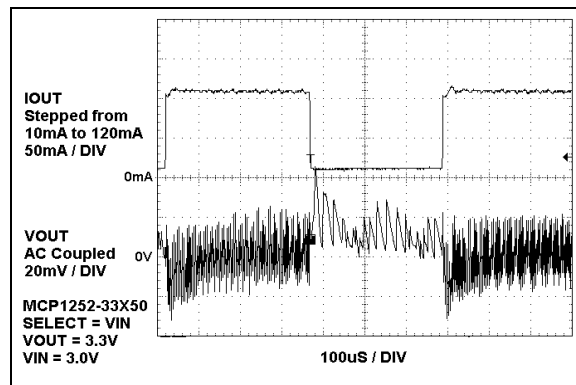
**FIGURE 2-8:** Output Voltage vs. Temperature (MCP1252-33X50, MCP1253-33X50).



**FIGURE 2-11:** Quiescent Current vs. Temperature (MCP1252-33X50).

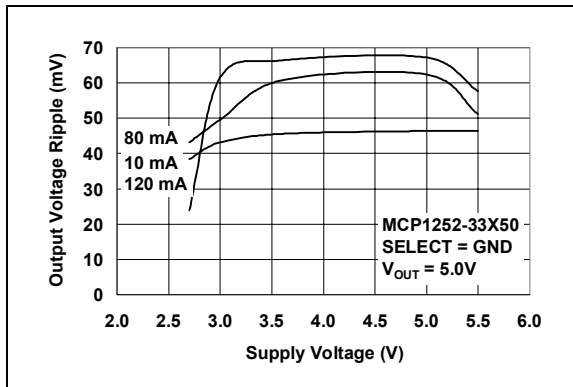


**FIGURE 2-9:** Line Transient Response.

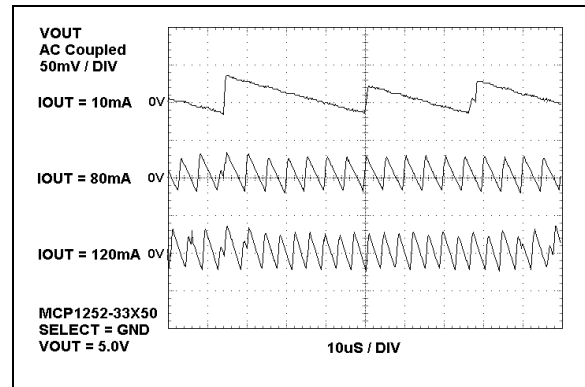


**FIGURE 2-12:** Load Transient Response.

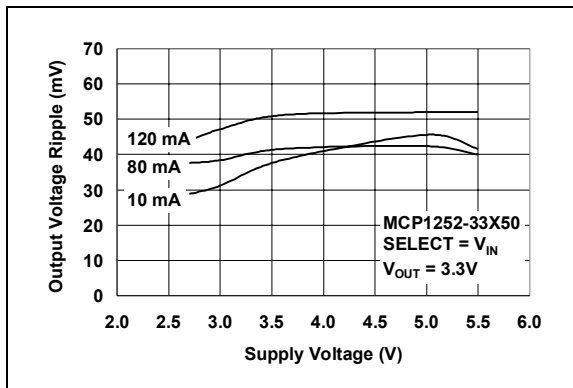
**Note:** Unless otherwise indicated,  $V_{IN} = 3.6V$ ,  $T_A = 25^\circ C$ ,  $C_{IN} = C_{OUT} = 10mF$ ,  $C_{FLY} = 1mF$ , all capacitors X7R ceramic.



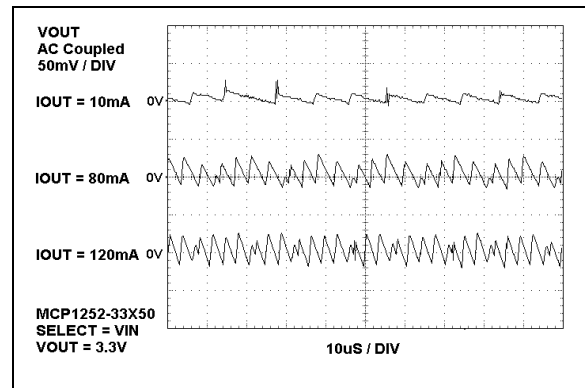
**FIGURE 2-13:** Output Voltage Ripple vs. Supply Voltage (MCP1252-33X50).



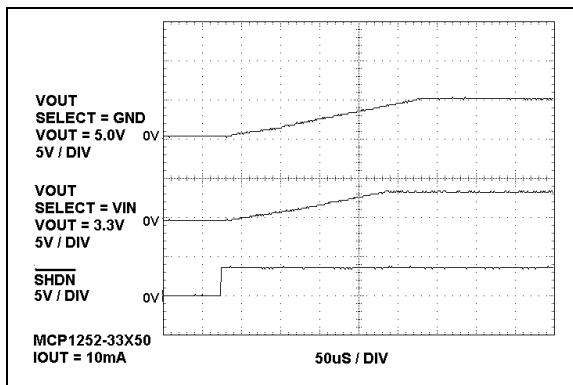
**FIGURE 2-16:** Output Voltage Ripple vs. Time.



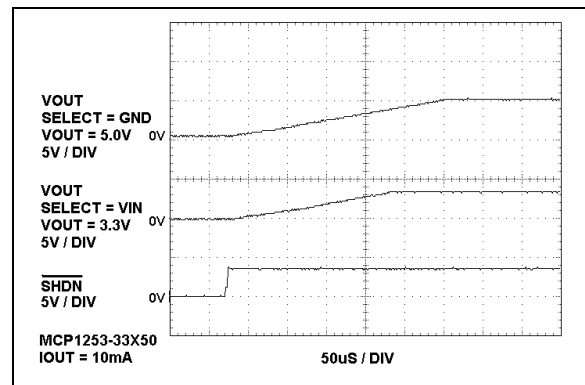
**FIGURE 2-14:** Output Voltage Ripple vs. Supply Voltage (MCP1252-33X50).



**FIGURE 2-17:** Output Voltage Ripple vs. Time.



**FIGURE 2-15:** Start-Up (MCP1252-33X50).



**FIGURE 2-18:** Start-Up (MCP1253-33X50).

# MCP1252/3

## 3.0 PIN FUNCTIONS

TABLE 3-1: PIN FUNCTION TABLE

| Pin No. | Name             | Function                                                               |
|---------|------------------|------------------------------------------------------------------------|
| 1       | PGOOD            | Open-Drain Power GOOD Output                                           |
| 2       | V <sub>OUT</sub> | Regulated Output Voltage                                               |
| 3       | V <sub>IN</sub>  | Power Supply Input                                                     |
| 4       | GND              | Ground Terminal                                                        |
| 5       | C-               | Flying Capacitor Negative Terminal                                     |
| 6       | C+               | Flying Capacitor Positive Terminal                                     |
| 7       | SHDN             | Shutdown Mode, Active-Low Input                                        |
| 8       | SELECT           | Output Voltage Select Pin.<br>(MCP1252-33X50, MCP1253-33X50)           |
|         | FB               | Feedback Input Pin for Adjustable Output<br>(MCP1252-ADJ, MCP1253-ADJ) |

### 3.1 Open-Drain Power Good Output (PGOOD)

PGOOD is a high-impedance when the output voltage is in regulation. A logic-low is asserted when the output falls 7% (typical) below the nominal value. The PGOOD output remains low until V<sub>OUT</sub> is within 3% (typical) of its nominal value. On start-up, this pin indicates when the output voltage reaches its final value. PGOOD is high-impedance when SHDN is low.

### 3.2 Regulated Output Voltage (V<sub>OUT</sub>)

Bypass to GND with a filter capacitor.

### 3.3 Power Supply Input (V<sub>IN</sub>)

It is recommended that V<sub>IN</sub> be tied to a ceramic bypass capacitor.

### 3.4 Ground (GND)

It is recommended that the ground pin be tied to a ground plane for best performance.

### 3.5 Flying Capacitor Negative Terminal (C-)

The charge pump capacitor (flying capacitor) is used to transfer charge from the input supply to the regulated output.

It is recommended that a low ESR (equivalent series resistance) capacitor be used.

### 3.6 Flying Capacitor Positive Terminal (C+)

The charge pump capacitor (flying capacitor) is used to transfer charge from the input supply to the regulated output.

Proper orientation is imperative when using a polarized capacitor.

### 3.7 Shutdown Input (SHDN)

A logic-low signal applied to  $\overline{\text{SHDN}}$  disables the device. A logic-high signal applied to this pin allows normal operation.

### 3.8 Select (SELECT) Input or Feedback (FB) Input

**MCP1252-33X50, MCP1253-33X50:**

**SELECT:** Select Input Pin.

Connect SELECT to V<sub>IN</sub> for 3.3V fixed output. Connect SELECT to GND for a 5.0V fixed output.

**MCP1252-ADJ, MCP1253-ADJ:**

**FB:** Feedback Pin.

A resistor divider connected to this pin determines the adjustable V<sub>OUT</sub> value (1.5V to 5.5V).

## 4.0 DEVICE OVERVIEW

### 4.1 Theory of Operation

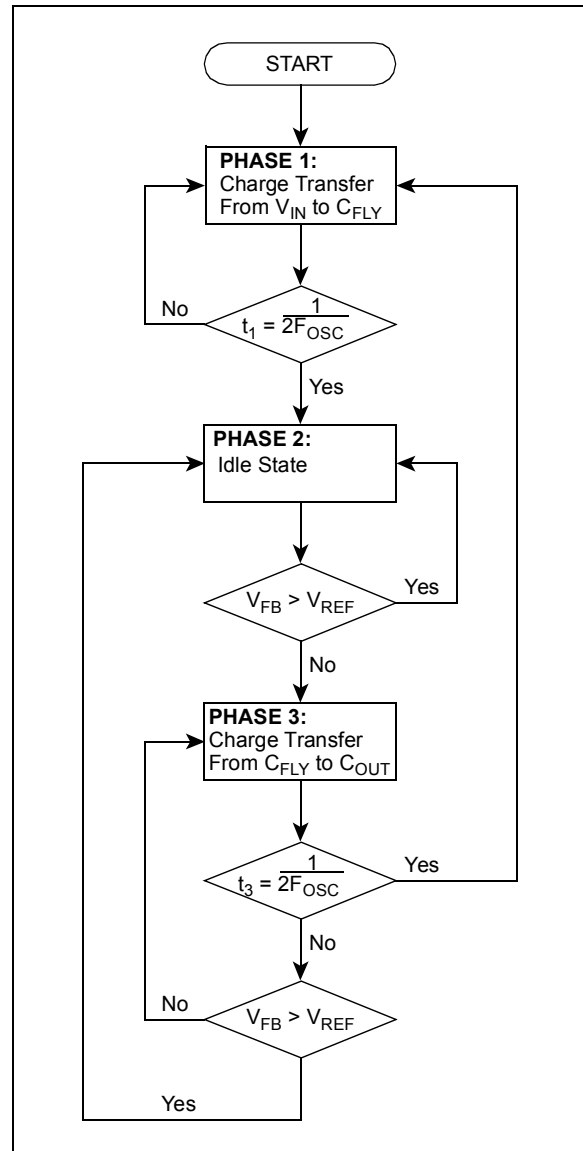
The MCP1252 and MCP1253 family of devices employ a switched capacitor charge pump to buck or boost an input supply voltage ( $V_{IN}$ ) to a regulated output voltage. Referring to the Functional Block Diagram and Figure 4-1, the devices perform conversion and regulation in three phases. When the devices are not in shut-down mode and a steady-state condition has been reached, the three phases are continuously cycled through. The first phase transfers charge from the input to the flying capacitor ( $C_{FLY}$ ) connected to pins C+ and C-. This phase always occurs for half of the internal oscillator period. During this phase, switches  $S_1$  and  $S_2$  are closed.

Once the first phase is complete, all switches are opened and the second phase (idle phase) is entered. The device compares the internal or external feedback voltage with an internal reference. If the feedback voltage is below the regulation point, the device transitions to the third phase.

The third phase transfers energy from the flying capacitor to the output capacitor connected to  $V_{OUT}$  and the load. If regulation is maintained, the device returns to the idle phase. If the charge transfer occurs for half the internal oscillator period, more charge is needed in the flying capacitor and the device transitions back to the first phase.

The regulation control is hysteretic, otherwise referred to as a bang-bang control. The output is regulated around a fixed reference with some hysteresis. As a result, typically 50 mV of peak-to-peak ripple will be observed at the output independent of load current. The frequency of the output ripple, however, will be influenced heavily by the load current and output capacitance. The maximum frequency that will be observed is equal to the internal oscillator frequency.

The devices automatically transition between buck or boost operation. This provides a low-cost, compact and simple solution for step-down/step-up DC/DC conversion. This is especially true for battery-operated applications that require a fixed output above or below the input.



**FIGURE 4-1:** Flow Algorithm.

# MCP1252/3

## 4.2 Power Efficiency

The power efficiency,  $\eta$ , is determined by the mode of operation. In boost mode, the efficiency is approximately half of a linear regulator. In buck mode, the efficiency is approximately equal to that of a linear regulator. The following formulas can be used to approximate the power efficiency with any significant amount of output current. At light loads, the quiescent current of the device must be taken into consideration.

### EQUATION

$$\eta_{BOOST} = \frac{P_{OUT}}{P_{IN}} = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times 2 \times I_{OUT}} = \frac{V_{OUT}}{V_{IN} \times 2}$$

$$\eta_{BUCK} = \frac{P_{OUT}}{P_{IN}} = \frac{V_{OUT} \times I_{OUT}}{V_{IN} \times I_{OUT}} = \frac{V_{OUT}}{V_{IN}}$$

## 4.3 Shutdown Mode

Driving  $\overline{SHDN}$  low places the MCP1252 or MCP1253 in a low power shutdown mode. This disables the charge pump switches, oscillator and control logic, reducing the quiescent current to 0.1  $\mu$ A (typical). The PGOOD output is in a high-impedance state during shutdown.

## 4.4 PGOOD Output

The PGOOD output is an open-drain output that sinks current when the regulator output voltage falls below 0.93 $V_{OUT}$  (typical). The output voltage can either be fixed when the selectable output device is chosen (MCP1252-33X50, MCP1253-33X50) or adjustable when the adjustable device is chosen (MCP1252-ADJ, MCP1253-ADJ). If the regulator output voltage falls below 0.93 $V_{OUT}$  (typical) for less than 200  $\mu$ sec and then recovers, glitch-immunity circuits prevent the PGOOD signal from transitioning low. A 10 k $\Omega$  to 1 M $\Omega$  pull-up resistor from PGOOD to  $V_{OUT}$  may be used to provide a logic output. Connect PGOOD to GND or leave unconnected if not used.

## 4.5 Soft-Start and Short-Circuit Protection

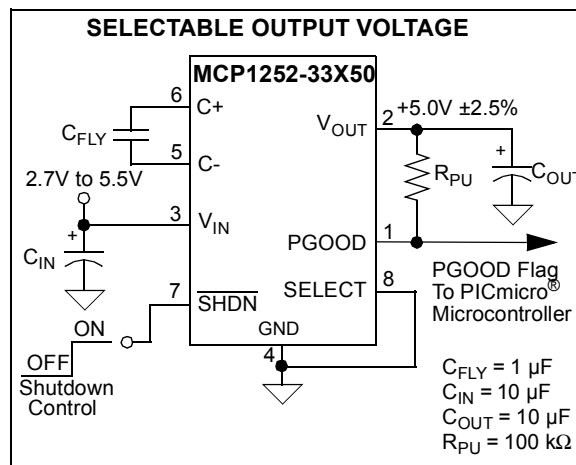
The MCP1252 and MCP1253 features foldback short-circuit protection. This circuitry provides an internal soft-start function by limiting in-rush current during startup and also limits the output current to 200 mA (typical) if the output is shorted to GND. The internal soft-start circuitry requires approximately 300  $\mu$ sec, typical with a 5V output, from either initial power-up or release from shutdown for the output voltage to be in regulation.

## 4.6 Thermal Shutdown

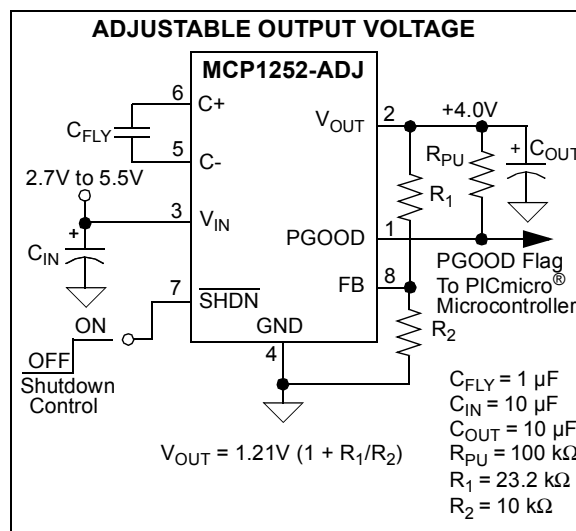
The MCP1252 and MCP1253 feature thermal shutdown with temperature hysteresis. When the die temperature exceeds 160°C, typically, the device shuts down. When the die cools by 15°C, typically, the device automatically turns back on. If high die temperature is caused by output overload and the load is not removed, the device will turn on and off, resulting in a pulse output.

## 5.0 APPLICATIONS

The MCP1252 and MCP1253 are inductorless, positive regulated, charge pump DC/DC converters. A typical circuit configuration for the fixed output version is depicted in Figure 5-1. The adjustable version is depicted in Figure 5-2.



**FIGURE 5-1:** Typical Circuit Configuration for Fixed Output Device.



**FIGURE 5-2:** Typical Circuit Configuration for Adjustable Output Device.

## 5.1 Capacitor Selection

The style and value of capacitors used with the MCP1252 and MCP1253 family of devices determine several important parameters such as output voltage ripple and charge pump strength. To minimize noise and ripple, it is recommended that low ESR (0.1  $\Omega$ ) capacitors be used for both  $C_{IN}$  and  $C_{OUT}$ . These capacitors should be either ceramic or tantalum and should be 10  $\mu$ F or higher. Aluminum capacitors are not recommended because of their high ESR.

If the source impedance to  $V_{IN}$  is very low, up to several megahertz,  $C_{IN}$  may not be required. Alternatively, a somewhat smaller value of  $C_{IN}$  may be substituted for the recommended 10  $\mu$ F, but will not be as effective in preventing ripple on the  $V_{IN}$  pin.

The value of  $C_{OUT}$  controls the amount of output voltage ripple present on  $V_{OUT}$ . Increasing the size of  $C_{OUT}$  will reduce output ripple at the expense of a slower turn-on time from shutdown and a higher in-rush current.

The flying capacitor ( $C_{FLY}$ ) controls the strength of the charge pump. In order to achieve the maximum rated output current (120 mA), it is necessary to have at least 1  $\mu$ F of capacitance for the flying capacitor. A smaller flying capacitor delivers less charge per clock cycle to the output capacitor, resulting in lower output ripple. The output ripple is reduced at the expense of maximum output current and efficiency.

## 5.2 Output Voltage Setting

The MCP1252-33X50 and MCP1253-33X50 feedback controllers select between an internally-set, regulated output voltage (3.3V or 5.0V). Connect SELECT to GND for a regulated 5.0V output and connect SELECT to  $V_{IN}$  for a regulated 3.3V output.

The MCP1252-ADJ and MCP1253-ADJ utilize an external resistor divider that allows the output voltage to be adjusted between 1.5V and 5.5V. For an adjustable output, connect a resistor between  $V_{OUT}$  and FB ( $R_1$ ) and another resistor between FB and GND ( $R_2$ ). In the following equation, choose  $R_2$  to be less than or equal to 30 k $\Omega$  and calculate  $R_1$  from the following formula:

### EQUATION

$$R_1 = R_2[(V_{OUT}/V_{FB}) - 1]$$

and

### EQUATION

$$V_{OUT} = V_{FB}(1 + R_1/R_2)$$

where:

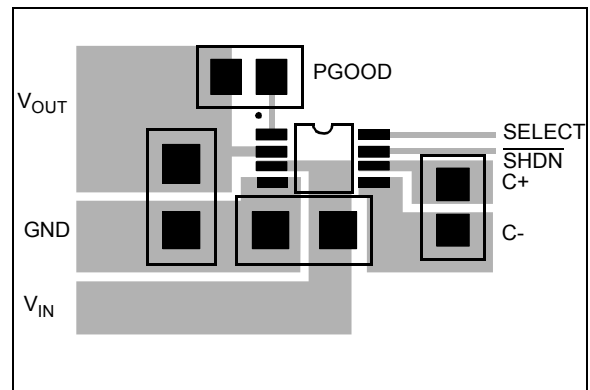
$V_{OUT}$  is the desired output voltage from 1.5V to 5.5V

$V_{FB}$  is the internal regulation voltage, nominally 1.21V

Note that the tolerance of the external resistors will have an effect on the accuracy of the output voltage. For optimum results, it is recommended that the external resistors have a tolerance no larger than 1%.

## 5.3 Recommended Layout

The MCP1252 and MCP1253 family of devices transfer charge at high switching frequencies, producing fast, high peak, transient currents. As a result, any stray inductance in the component layout will produce unwanted noise in the system. Proper board layout techniques are required to ensure optimum performance. Figure 5-3 depicts the recommended board layout. The input capacitor connected between  $V_{IN}$  and GND, and the output capacitor connected between  $V_{OUT}$  and GND, are 10  $\mu$ F ceramic, X7R dielectric, in 1206 packages. The flying capacitor connected between C+ and C- is a 1  $\mu$ F ceramic, X7R dielectric in a 0805 package. The layout is scaled 3:1.

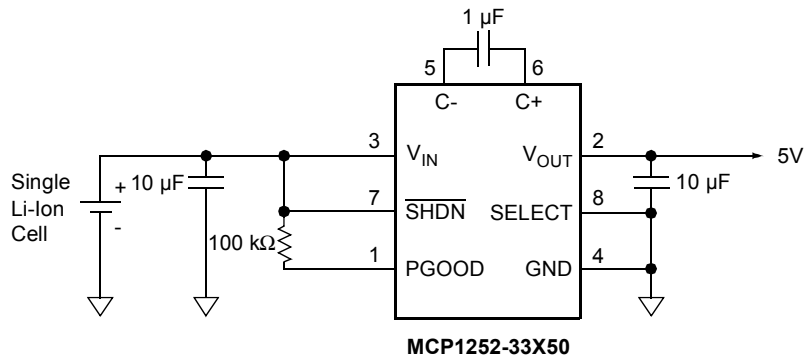


**FIGURE 5-3:** Recommended Printed Circuit Board Layout.

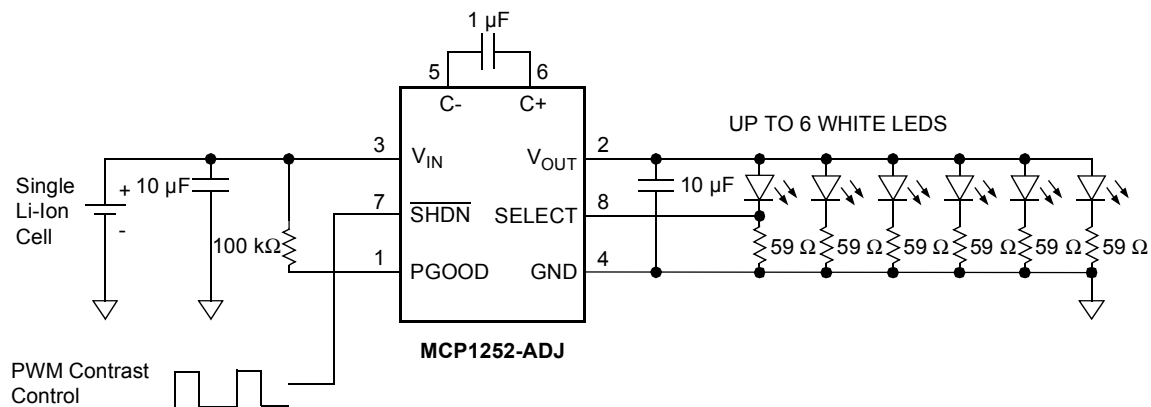
# MCP1252/3

## 6.0 TYPICAL APPLICATION CIRCUITS

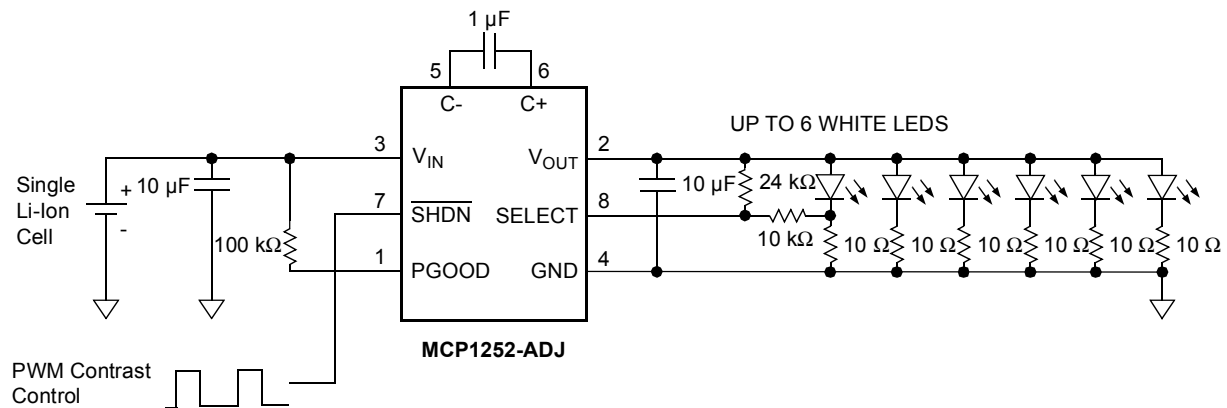
### Single Cell Lithium-Ion Battery To 5V Converter



### White LED Bias



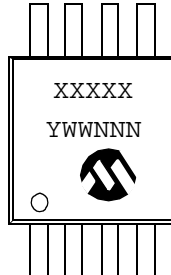
### Alternative White LED Bias



## 7.0 PACKAGING INFORMATION

### 7.1 Package Marking

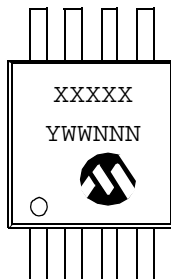
8-Lead MSOP (Fixed)



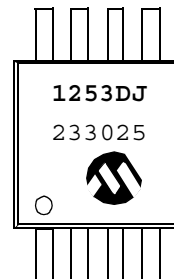
Example:



8-Lead MSOP (Adjustable)



Example:



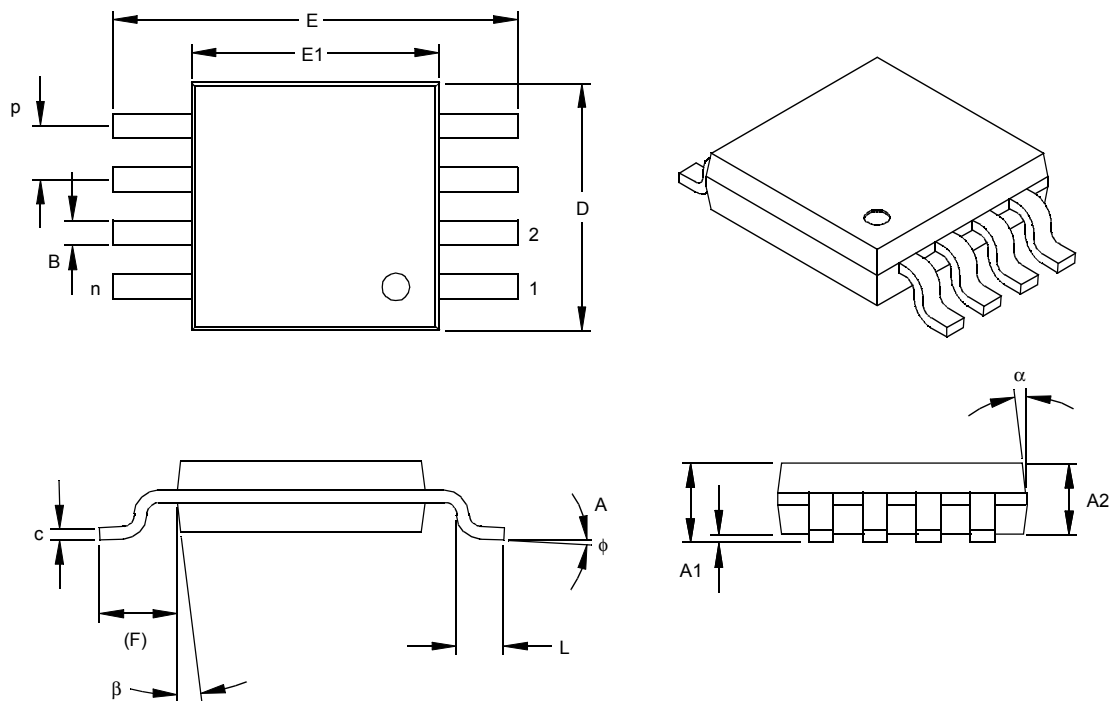
|                |        |                                            |
|----------------|--------|--------------------------------------------|
| <b>Legend:</b> | XX...X | Customer specific information*             |
|                | YY     | Year code (last 2 digits of calendar year) |
|                | WW     | Week code (week of January 1 is week '01') |
|                | NNN    | Alphanumeric traceability code             |

**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.

\* Standard OTP marking consists of Microchip part number, year code, week code, and traceability code.

# MCP1252/3

## 8-Lead Plastic Micro Small Outline Package (MS) (MSOP)



| Units                    |    | INCHES |      |      | MILLIMETERS* |      |      |
|--------------------------|----|--------|------|------|--------------|------|------|
| Dimension Limits         |    | MIN    | NOM  | MAX  | MIN          | NOM  | MAX  |
| Number of Pins           | n  |        | 8    |      |              |      | 8    |
| Pitch                    | p  | .026   |      |      | 0.65         |      |      |
| Overall Height           | A  |        |      | .044 |              |      | 1.18 |
| Molded Package Thickness | A2 | .030   | .034 | .038 | 0.76         | 0.86 | 0.97 |
| Standoff §               | A1 | .002   |      | .006 | 0.05         |      | 0.15 |
| Overall Width            | E  | .184   | .193 | .200 | 4.67         | 4.90 | 5.08 |
| Molded Package Width     | E1 | .114   | .118 | .122 | 2.90         | 3.00 | 3.10 |
| Overall Length           | D  | .114   | .118 | .122 | 2.90         | 3.00 | 3.10 |
| Foot Length              | L  | .016   | .022 | .028 | 0.40         | 0.55 | 0.70 |
| Footprint (Reference)    | F  | .035   | .037 | .039 | 0.90         | 0.95 | 1.00 |
| Foot Angle               | φ  | 0      |      | 6    | 0            |      | 6    |
| Lead Thickness           | c  | .004   | .006 | .008 | 0.10         | 0.15 | 0.20 |
| Lead Width               | B  | .010   | .012 | .016 | 0.25         | 0.30 | 0.40 |
| Mold Draft Angle Top     | α  |        | 7    |      |              | 7    |      |
| Mold Draft Angle Bottom  | β  |        | 7    |      |              | 7    |      |

\*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.

Drawing No. C04-111

## PRODUCT IDENTIFICATION SYSTEM

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

| <u>PART NO.</u>    |  | <u>X</u>                                                                                                                                                                                                                                               | <u>/XX</u>                                                                                       |
|--------------------|--|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Device             |  | Temperature Range                                                                                                                                                                                                                                      | Package                                                                                          |
| Device:            |  | MCP1252: Low Noise, Positive-Regulated Charge Pump<br>MCP1252T: Low Noise, Positive-Regulated Charge Pump (Tape and Reel)<br>MCP1253: Low Noise, Positive-Regulated Charge Pump<br>MCP1253T: Low Noise, Positive-Regulated Charge Pump (Tape and Reel) |                                                                                                  |
| Temperature Range: |  | I = -40°C to +85°C                                                                                                                                                                                                                                     |                                                                                                  |
| Package:           |  | MS = Plastic Micro Small Outline (MSOP), 8-lead                                                                                                                                                                                                        |                                                                                                  |
|                    |  |                                                                                                                                                                                                                                                        | <b>Examples:</b>                                                                                 |
|                    |  |                                                                                                                                                                                                                                                        | a) MCP1252-33X50I/MS: Low Noise, Positive-Regulated Charge Pump, Fixed Output                    |
|                    |  |                                                                                                                                                                                                                                                        | b) MCP1252-ADJI/MS: Low Noise, Positive-Regulated Charge Pump, Adjustable Output                 |
|                    |  |                                                                                                                                                                                                                                                        | c) MCP1252T-33X50I/MS: Tape and Reel, Low Noise, Positive-Regulated Charge Pump, Fixed Output    |
|                    |  |                                                                                                                                                                                                                                                        | a) MCP1253-33X50I/MS: Low Noise, Positive-Regulated Charge Pump, Fixed Output                    |
|                    |  |                                                                                                                                                                                                                                                        | b) MCP1253-ADJI/MS: Low Noise, Positive-Regulated Charge Pump, Adjustable Output                 |
|                    |  |                                                                                                                                                                                                                                                        | c) MCP1253T-ADJI/MS: Tape and Reel, Low Noise, Positive-Regulated Charge Pump, Adjustable Output |

## Sales and Support

### Data Sheets

Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site ([www.microchip.com](http://www.microchip.com))

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

### New Customer Notification System

Register on our web site ([www.microchip.com/cn](http://www.microchip.com/cn)) to receive the most current information on our products.

# MCP1252/3

---

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."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products.

---

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.

#### Trademarks

The Microchip name and logo, the Microchip logo, KEELOQ, MPLAB, PIC, PICmicro, PICSTART and PRO MATE are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

FilterLab, microID, MXDEV, MXLAB, PICMASTER, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

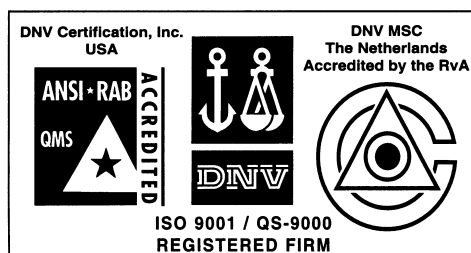
dsPIC, dsPICDEM.net, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, microPort, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, PICC, PICDEM, PICDEM.net, rPIC, Select Mode and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

Serialized Quick Turn Programming (SQTP) is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2002, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.



*Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.*



## WORLDWIDE SALES AND SERVICE

### AMERICAS

#### Corporate Office

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200 Fax: 480-792-7277  
Technical Support: 480-792-7627  
Web Address: <http://www.microchip.com>

#### Rocky Mountain

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7966 Fax: 480-792-4338

#### Atlanta

3780 Mansell Road, Suite 130  
Alpharetta, GA 30022  
Tel: 770-640-0034 Fax: 770-640-0307

#### Boston

2 Lan Drive, Suite 120  
Westford, MA 01886  
Tel: 978-692-3848 Fax: 978-692-3821

#### Chicago

333 Pierce Road, Suite 180  
Itasca, IL 60143  
Tel: 630-285-0071 Fax: 630-285-0075

#### Dallas

4570 Westgrove Drive, Suite 160  
Addison, TX 75001  
Tel: 972-818-7423 Fax: 972-818-2924

#### Detroit

Tri-Atria Office Building  
32255 Northwestern Highway, Suite 190  
Farmington Hills, MI 48334  
Tel: 248-538-2250 Fax: 248-538-2260

#### Kokomo

2767 S. Albright Road  
Kokomo, Indiana 46902  
Tel: 765-864-8360 Fax: 765-864-8387

#### Los Angeles

18201 Von Karman, Suite 1090  
Irvine, CA 92612  
Tel: 949-263-1888 Fax: 949-263-1338

#### San Jose

Microchip Technology Inc.  
2107 North First Street, Suite 590  
San Jose, CA 95131  
Tel: 408-436-7950 Fax: 408-436-7955

#### Toronto

6285 Northam Drive, Suite 108  
Mississauga, Ontario L4V 1X5, Canada  
Tel: 905-673-0699 Fax: 905-673-6509

### ASIA/PACIFIC

#### Australia

Microchip Technology Australia Pty Ltd  
Suite 22, 41 Rawson Street  
Epping 2121, NSW  
Australia  
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

#### China - Beijing

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Beijing Liaison Office  
Unit 915  
Bei Hai Wan Tai Bldg.  
No. 6 Chaoyangmen Beidajie  
Beijing, 100027, No. China  
Tel: 86-10-85282100 Fax: 86-10-85282104

#### China - Chengdu

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Chengdu Liaison Office  
Rm. 2401-2402, 24th Floor,  
Ming Xing Financial Tower  
No. 88 TIDU Street  
Chengdu 610016, China  
Tel: 86-28-86766200 Fax: 86-28-86766599

#### China - Fuzhou

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Fuzhou Liaison Office  
Unit 28F, World Trade Plaza  
No. 71 Wusi Road  
Fuzhou 350001, China  
Tel: 86-591-7503506 Fax: 86-591-7503521

#### China - Shanghai

Microchip Technology Consulting (Shanghai)  
Co., Ltd.  
Room 701, Bldg. B  
Far East International Plaza  
No. 317 Xian Xia Road  
Shanghai, 200051  
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

#### China - Shenzhen

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Shenzhen Liaison Office  
Rm. 15-16, 13/F, Shenzhen Kerry Centre,  
Renminnan Lu  
Shenzhen 518001, China  
Tel: 86-755-82350361 Fax: 86-755-82366086

#### China - Hong Kong SAR

Microchip Technology Hongkong Ltd.  
Unit 901-6, Tower 2, Metroplaza  
223 Hing Fong Road  
Kwai Fong, N.T., Hong Kong  
Tel: 852-2401-1200 Fax: 852-2401-3431

#### India

Microchip Technology Inc.  
India Liaison Office  
Divyasree Chambers  
1 Floor, Wing A (A3/A4)  
No. 11, O'Shaughnessy Road  
Bangalore, 560 025, India  
Tel: 91-80-2290061 Fax: 91-80-2290062

### Japan

Microchip Technology Japan K.K.  
Benex S-1 6F  
3-18-20, Shinyokohama  
Kohoku-Ku, Yokohama-shi  
Kanagawa, 222-0033, Japan  
Tel: 81-45-471-6166 Fax: 81-45-471-6122

### Korea

Microchip Technology Korea  
168-1, Youngbo Bldg. 3 Floor  
Samsung-Dong, Kangnam-Ku  
Seoul, Korea 135-882  
Tel: 82-2-554-7200 Fax: 82-2-558-5934

### Singapore

Microchip Technology Singapore Pte Ltd.  
200 Middle Road  
#07-02 Prime Centre  
Singapore, 188980  
Tel: 65-6334-8870 Fax: 65-6334-8850

### Taiwan

Microchip Technology (Barbados) Inc.,  
Taiwan Branch  
11F-3, No. 207  
Tung Hua North Road  
Taipei, 105, Taiwan  
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

### EUROPE

#### Austria

Microchip Technology Austria GmbH  
Durisolstrasse 2  
A-4600 Wels  
Austria  
Tel: 43-7242-2244-399  
Fax: 43-7242-2244-393

#### Denmark

Microchip Technology Nordic ApS  
Regus Business Centre  
Lautrup høj 1-3  
Ballerup DK-2750 Denmark  
Tel: 45 4420 9895 Fax: 45 4420 9910

#### France

Microchip Technology SARL  
Parc d'Activite du Moulin de Massy  
43 Rue du Saule Trapu  
Batiment A - 1er Etage  
91300 Massy, France  
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

#### Germany

Microchip Technology GmbH  
Steinheilstrasse 10  
D-85737 Ismaning, Germany  
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

#### Italy

Microchip Technology SRL  
Centro Direzionale Colleoni  
Palazzo Taurus 1 V. Le Colleoni 1  
20041 Agrate Brianza  
Milan, Italy  
Tel: 39-039-65791-1 Fax: 39-039-6899883

#### United Kingdom

Microchip Ltd.  
505 Eskdale Road  
Winnersh Triangle  
Wokingham  
Berkshire, England RG41 5TU  
Tel: 44 118 921 5869 Fax: 44-118 921-5820

11/15/02