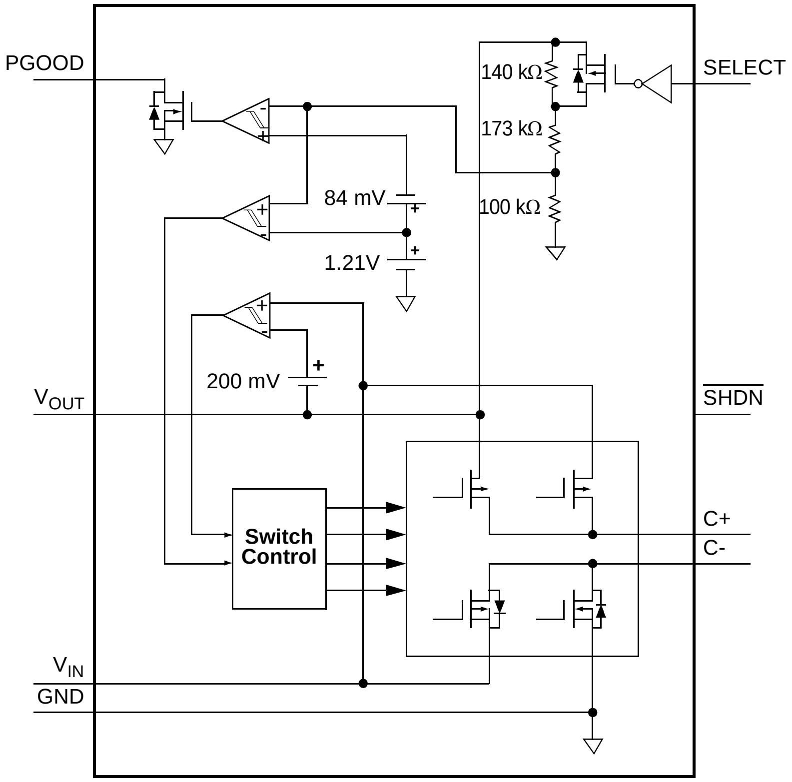
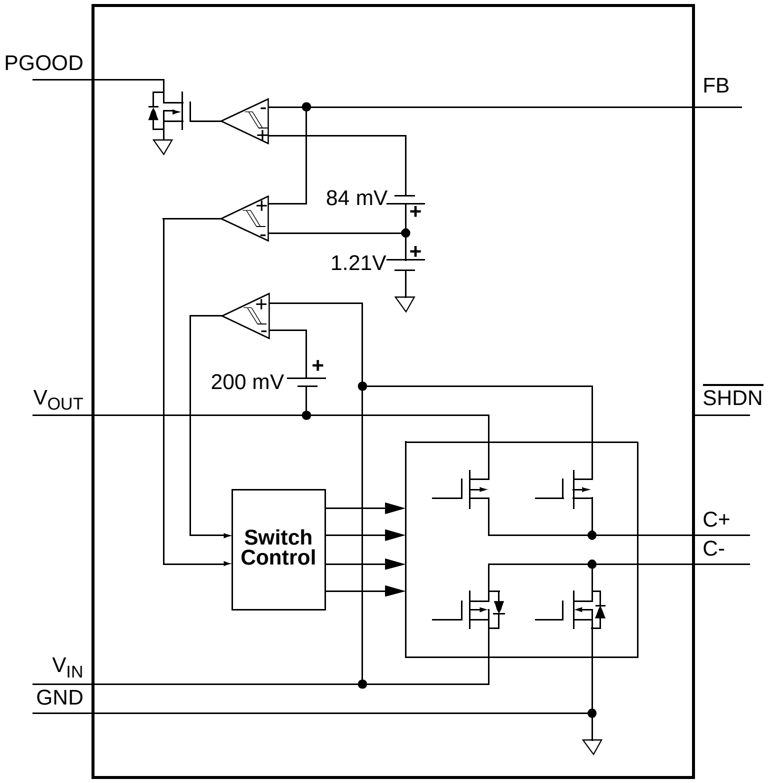
Functional Block Diagram

MCP1252-33X50
MCP1253-33X50



MCP1252-ADJ
MCP1253-ADJ



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 kΩ in Series with 100 pF) ..... ≥ 4 kV

Machine Body Model (200 pF, No Series Resistance) ≥ 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.

ELECTRICAL CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, all limits are specified for T_A = -40°C to +85°C ("I" Temperature), T_A = -40°C to +125°C ("E" Temperature), $\overline{SHDN} = V_{IN}$, $C_{IN} = C_{OUT}$ = 10 µF, C_{FLY} = 1 µF, I_{OUT} = 10 mA. Typical values are for T_A = +25°C.

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Selectable Output - MCP1252-33X50, MCP1253-33X50: SELECT = V_{IN}, V_{OUT} = 3.3V						
Supply Voltage	V_{IN}	2.1	—	5.5	V	
Output Voltage Accuracy	V_{OUT}	-2.5	±0.5	+2.5	%	2.3V ≤ V_{IN} < 2.5V, I_{OUT} ≤ 80 mA 2.5V ≤ V_{IN} ≤ 5.5V, I_{OUT} ≤ 120 mA
Output Current	I_{OUT}	80	100	—	mA	2.3V ≤ V_{IN} < 2.5V
		120	150	—	mA	2.5V ≤ V_{IN} ≤ 5.5V
SELECT Logic Input Voltage High	V_{IH}	1.4	—	—	V	MCP1252-33X50, MCP1253-33X50
Selectable Output - MCP1252-33X50, MCP1253-33X50: SELECT = GND, V_{OUT} = 5.0V						
Supply Voltage	V_{IN}	2.7	—	5.5	V	
Output Voltage Accuracy	V_{OUT}	-2.5	±0.5	+2.5	%	2.7V ≤ V_{IN} < 3.0V, I_{OUT} ≤ 40 mA 3.0V ≤ V_{IN} ≤ 5.5V, I_{OUT} ≤ 120 mA
Output Current	I_{OUT}	40	80	—	mA	2.7V ≤ V_{IN} < 3.0V
		120	150	—		3.0V ≤ V_{IN} ≤ 5.5V
SELECT Logic Input Voltage Low	V_{IL}	—	—	0.4	V	MCP1252-33X50, MCP1253-33X50
Adjustable Output - MCP1252-ADJ, MCP1253-ADJ						
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
ALL DEVICES						
Supply Current	I_{DD}	—	60	120	µA	No load
Output Short-Circuit Current	I_{SC}	—	200	—	mA	V_{OUT} = GND, foldback current
Shutdown Current	I_{SHDN}	—	0.1	2.0	µA	$\overline{SHDN}$ = 0V
Power Efficiency	η	—	81	—	%	V_{IN} = 3.0V, V_{OUT} = 5V I_{OUT} =120 mA
		—	68	—		V_{IN} = 3.6V, V_{OUT} = 5V I_{OUT} =120 mA
$\overline{SHDN}$ Logic Input Voltage Low	V_{IL}	—	—	0.4	V	
$\overline{SHDN}$ Logic Input Voltage High	V_{IH}	1.4	—	—	V	
PGOOD Output Voltage	P_{GOOD_VOL}	—	0.01	—	V	I_{PGOOD} = 0.5 mA
PGOOD Threshold Voltage	V_{TH}	—	$0.93V_{OUT}$	—	V	
PGOOD Hysteresis	V_{HYS}	—	$0.04V_{OUT}$	—	V	

AC CHARACTERISTICS

Electrical Specifications: Unless otherwise specified, all limits are specified for T_A = -40°C to +85°C ("I" Temperature), T_A = -40°C to +125°C ("E" Temperature), $\overline{SHDN}$ = V_{IN}, C_{IN} = C_{OUT} = 10 µF, C_{FLY} = 1 µF, I_{OUT} = 10 mA. Typical values are for T_A = +25°C.

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

TEMPERATURE SPECIFICATIONS

Parameters	Symbol	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges:						
Specified Temperature Range	T_A	-40	—	+85	°C	"I" Temperature range
		-40	—	+125		"E" Temperature range
Maximum Operating Junction Temperature	T_J	—	—	+125	°C	
Storage Temperature Range	T_A	-65	—	+150	°C	
Thermal Package Resistances:						
Thermal Resistance, 8 Pin MSOP	θ_{JA}	—	206	—	°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°C, C_{IN} = C_{OUT} = 10 µF, C_{FLY} = 1 µF, all capacitors X7R ceramic.

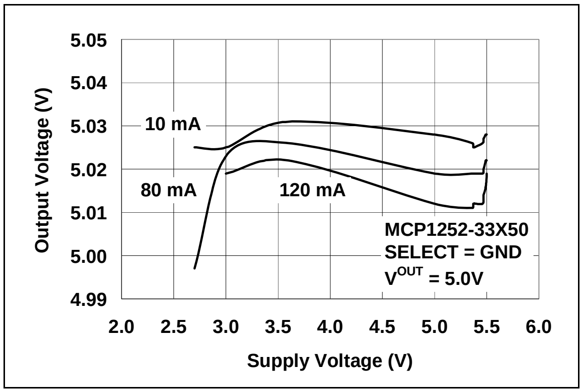


FIGURE 2-1: Output Voltage vs. Supply Voltage (MCP1252-33X50).

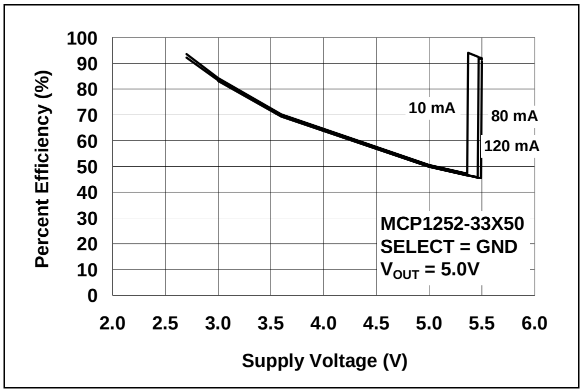


FIGURE 2-4: Percent Efficiency vs. Supply Voltage (MCP1252-33X50).

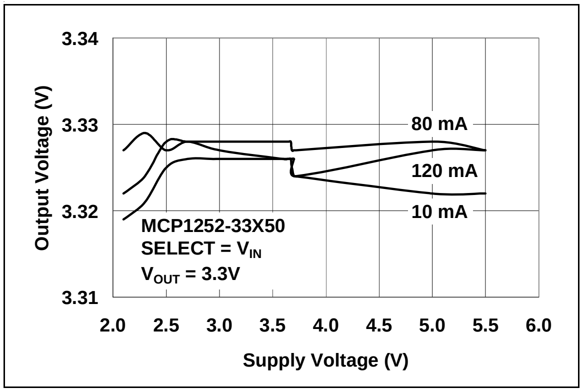


FIGURE 2-2: Output Voltage vs. Supply Voltage (MCP1252-33X50).

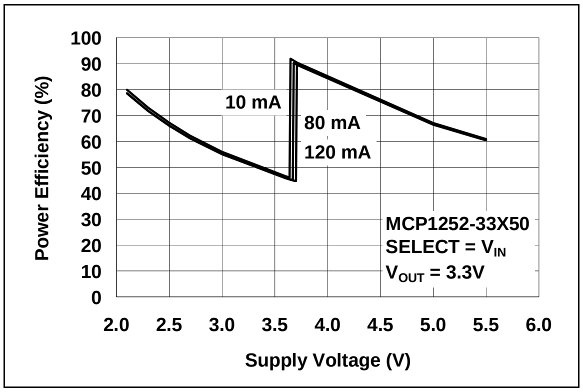


FIGURE 2-5: Power Efficiency vs. Supply Voltage (MCP1252-33X50).

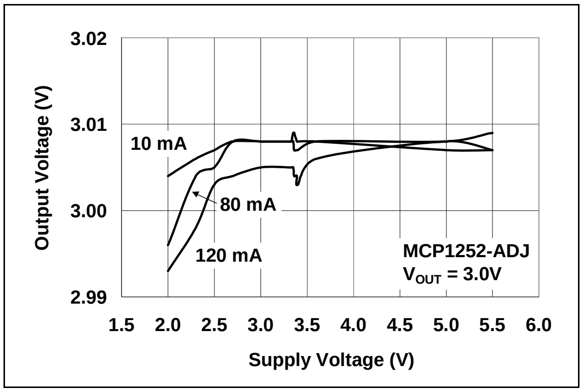


FIGURE 2-3: Output Voltage vs. Supply Voltage (MCP1252-ADJ).

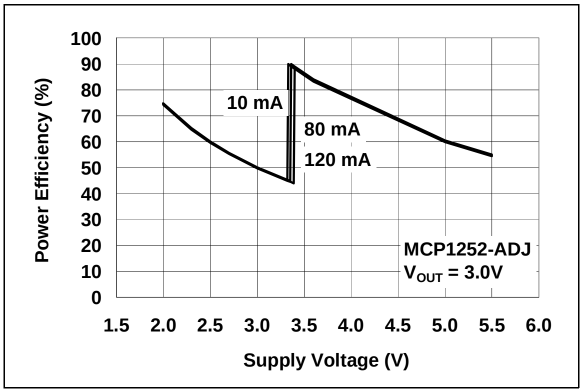


FIGURE 2-6: Power Efficiency vs. Supply Voltage (MCP1252-ADJ).

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

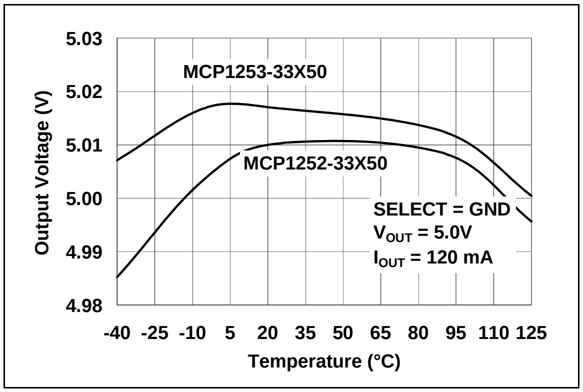


FIGURE 2-7: *Output Voltage vs. Temperature (MCP1252-33X50, MCP1253-33X50).*

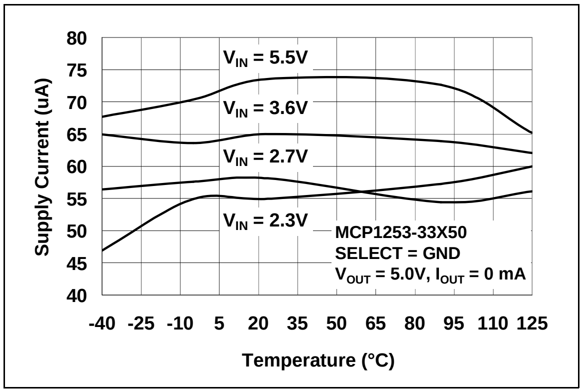


FIGURE 2-10: *Quiescent Current vs. Temperature (MCP1253-33X50).*

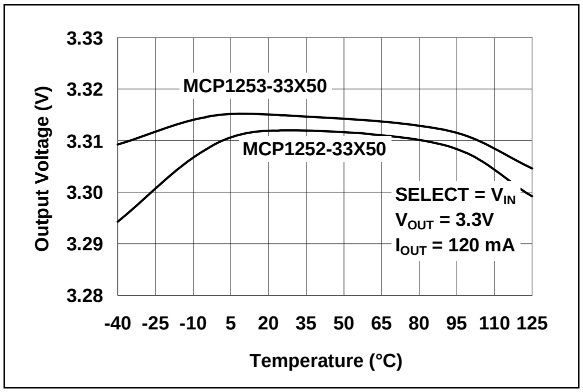


FIGURE 2-8: *Output Voltage vs. Temperature (MCP1252-33X50, MCP1253-33X50).*

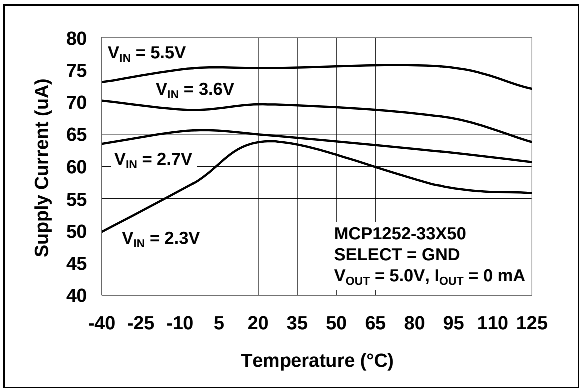


FIGURE 2-11: *Quiescent Current vs. Temperature (MCP1252-33X50).*

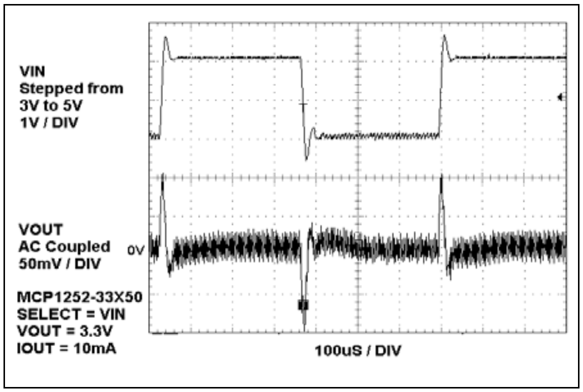


FIGURE 2-9: *Line Transient Response.*

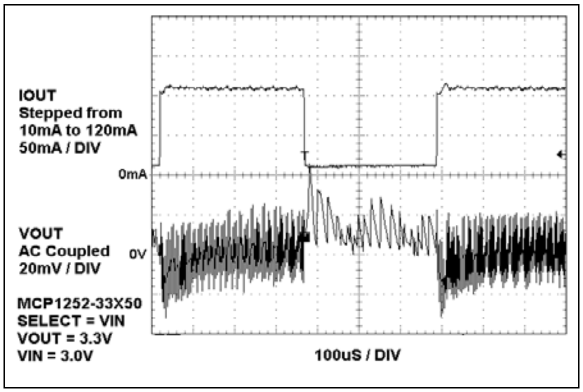


FIGURE 2-12: *Load Transient Response.*

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

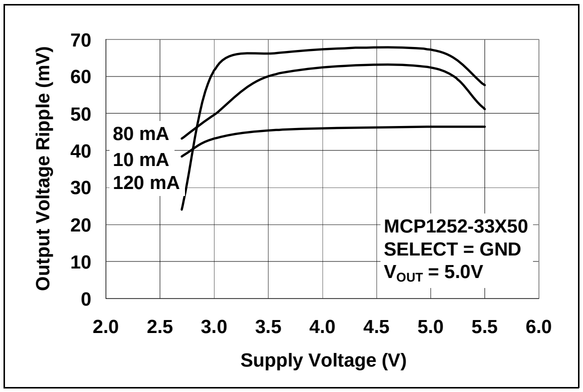


FIGURE 2-13: *Output Voltage Ripple vs. Supply Voltage (MCP1252-33X50).*

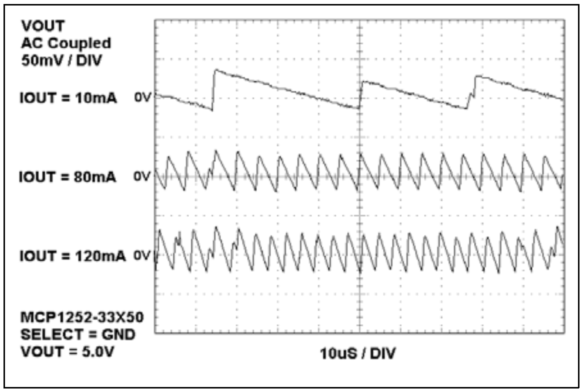


FIGURE 2-16: *Output Voltage Ripple vs. Time.*

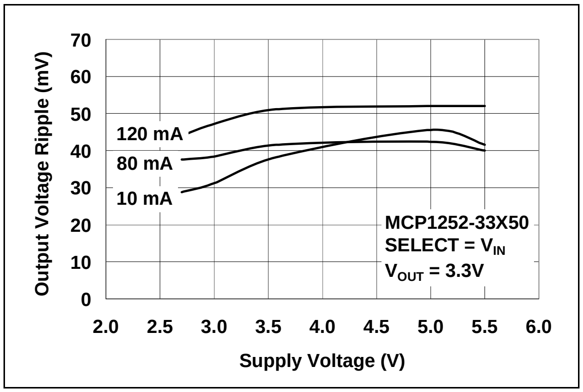


FIGURE 2-14: *Output Voltage Ripple vs. Supply Voltage (MCP1252-33X50).*

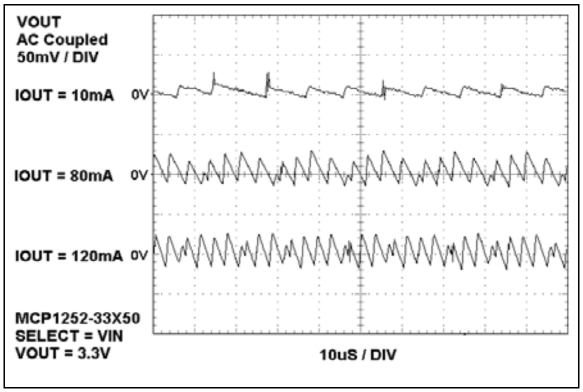


FIGURE 2-17: *Output Voltage Ripple vs. Time.*

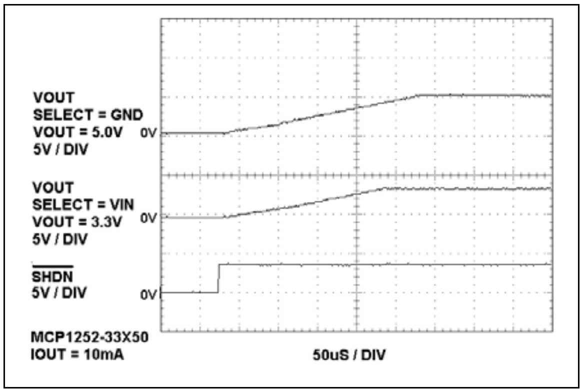


FIGURE 2-15: *Start-Up (MCP1252-33X50).*

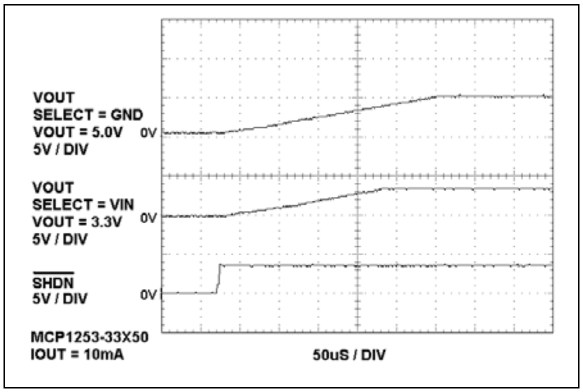


FIGURE 2-18: *Start-Up (MCP1253-33X50).*

3.0 PIN FUNCTIONS

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

TABLE 3-1: PIN FUNCTION TABLE

Pin No.	Name	Function
1	PGOOD	Open-Drain Power GOOD Output
2	V_{OUT}	Regulated Output Voltage
3	V_{IN}	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 (MCP1252-33X50, MCP1253-33X50)
	FB	Feedback Input Pin for Adjustable Output (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_{OUT} 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 $\overline{\text{SHDN}}$ is low.

3.2 Regulated Output Voltage (V_{OUT})

Bypass to GND with a filter capacitor.

3.3 Power Supply Input (V_{IN})

It is recommended that V_{IN} 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 ($\overline{\text{SHDN}}$)

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_{IN} 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_{OUT} 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 shutdown 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.

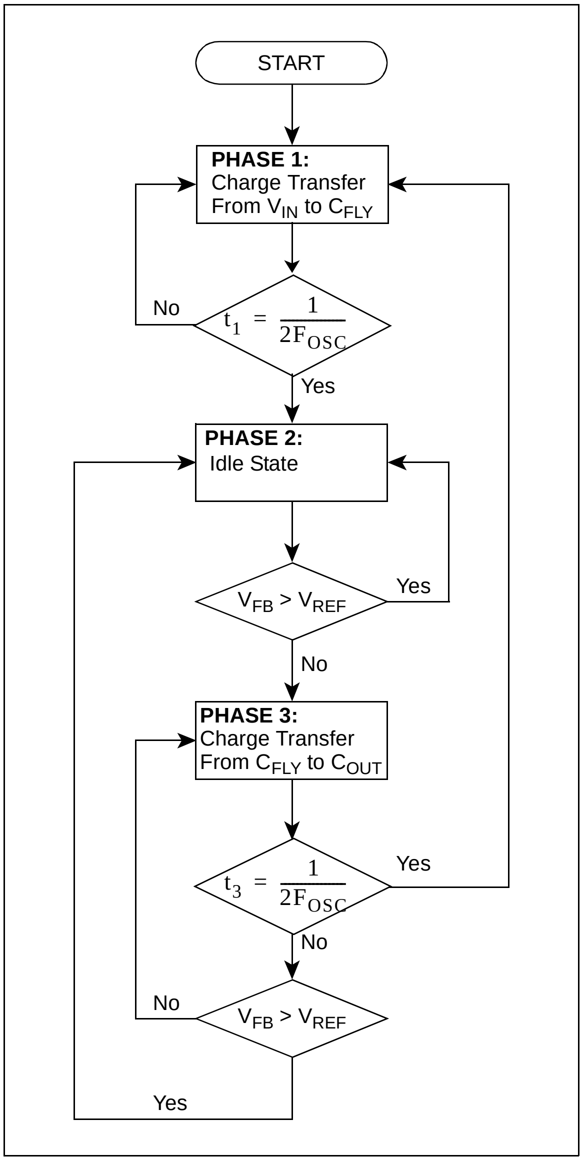


FIGURE 4-1: *Flow Algorithm.*

4.2 Power Efficiency

The power efficiency, η, 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 4-1:

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

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

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 µA (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 $0.93V_{OUT}$ (typical). The output voltage can either be fixed when the selectable output device is chosen (MCP1252-33X50, MCP1253-33X50) or adjustable from an external resistive divider when the adjustable device is chosen (MCP1252-ADJ, MCP1253-ADJ). If the regulator output voltage falls below $0.93V_{OUT}$ (typical) for less than 200 µsec and then recovers, glitch-immunity circuits prevent the PGOOD signal from transitioning low. A 10 kΩ to 1 MΩ 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 feature 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 µsec, 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.

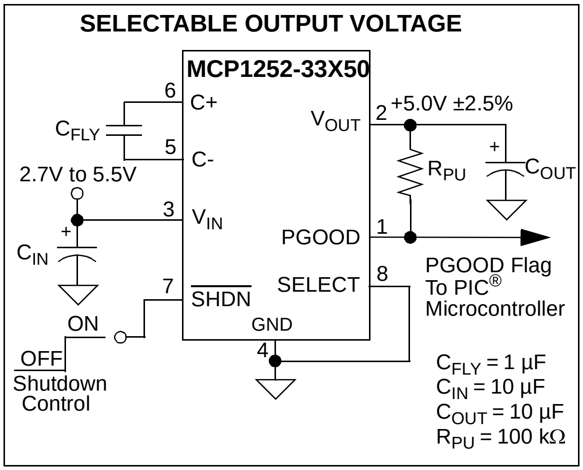


FIGURE 5-1: Typical Circuit Configuration for Fixed Output Device.

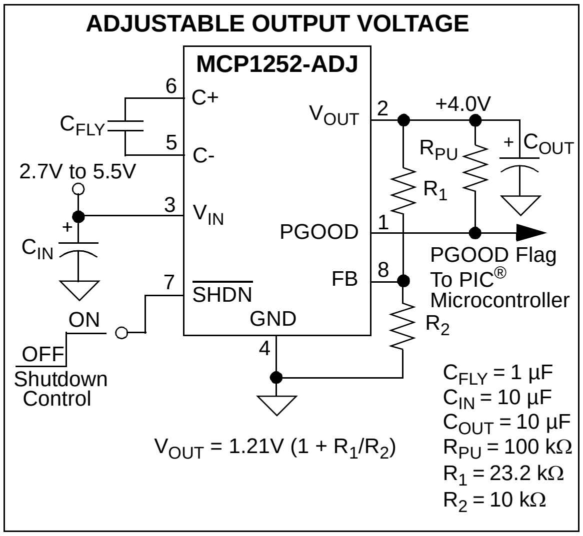


FIGURE 5-2: Typical Circuit Configuration for Adjustable Output Device.

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 Ω) capacitors be used for both C_{IN} and C_{OUT}. These capacitors should be either ceramic or tantalum and should be 10 µF 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 µF, 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 µF 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 kΩ and calculate R_1 from the following formula:

EQUATION 5-1:

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

and:

EQUATION 5-2:

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

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 µF ceramic, X7R dielectric, in 1206 packages. The flying capacitor connected between C+ and C- is a 1 µF ceramic, X7R dielectric in a 0805 package. The layout is scaled 3:1.

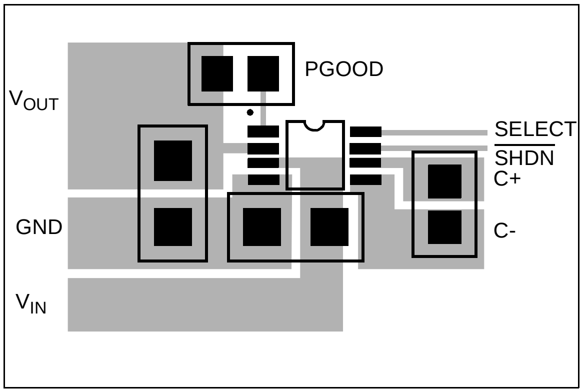
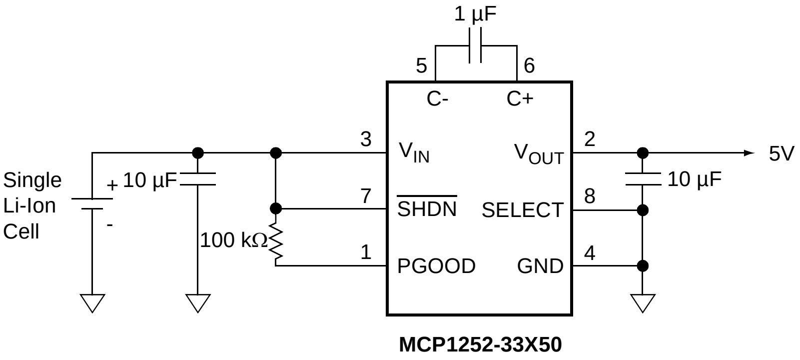


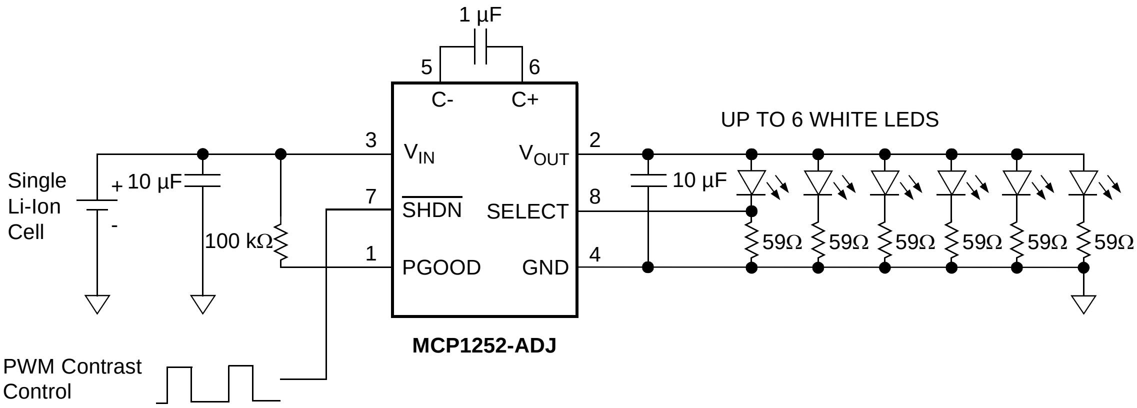
FIGURE 5-3: *Recommended Printed Circuit Board Layout.*

6.0 TYPICAL APPLICATION CIRCUITS

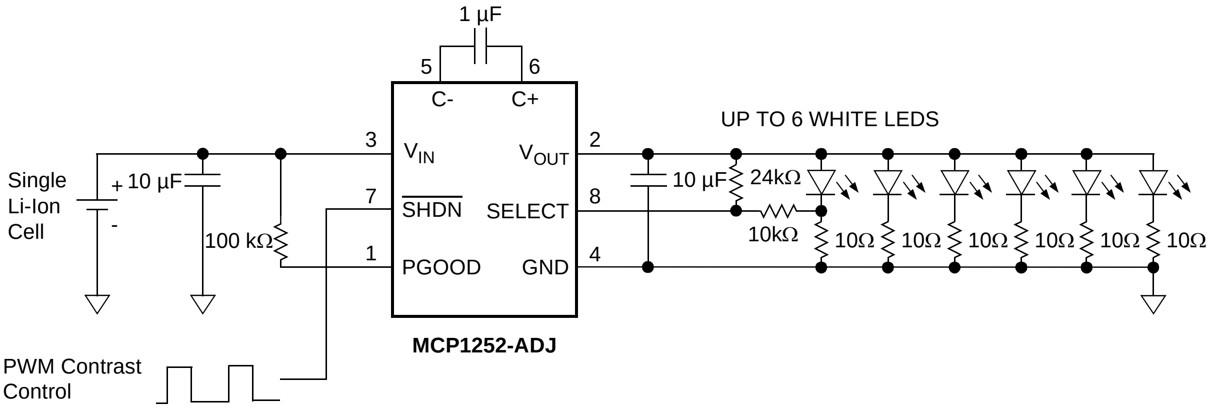
Single Cell Lithium-Ion Battery To 5V Converter



White LED Bias



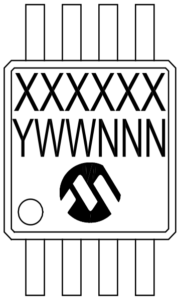
Alternative White LED Bias



7.0 PACKAGING INFORMATION

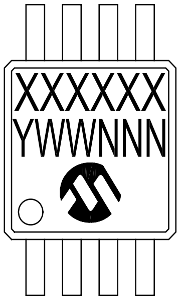
7.1 Package Marking

8-Lead MSOP (Fixed)

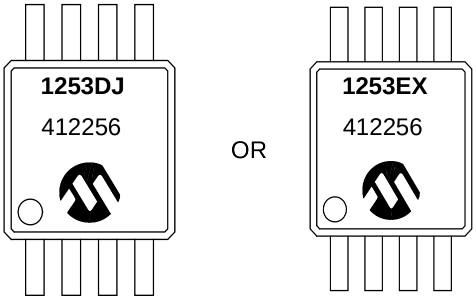


Example:

8-Lead MSOP (Adjustable)



Example:

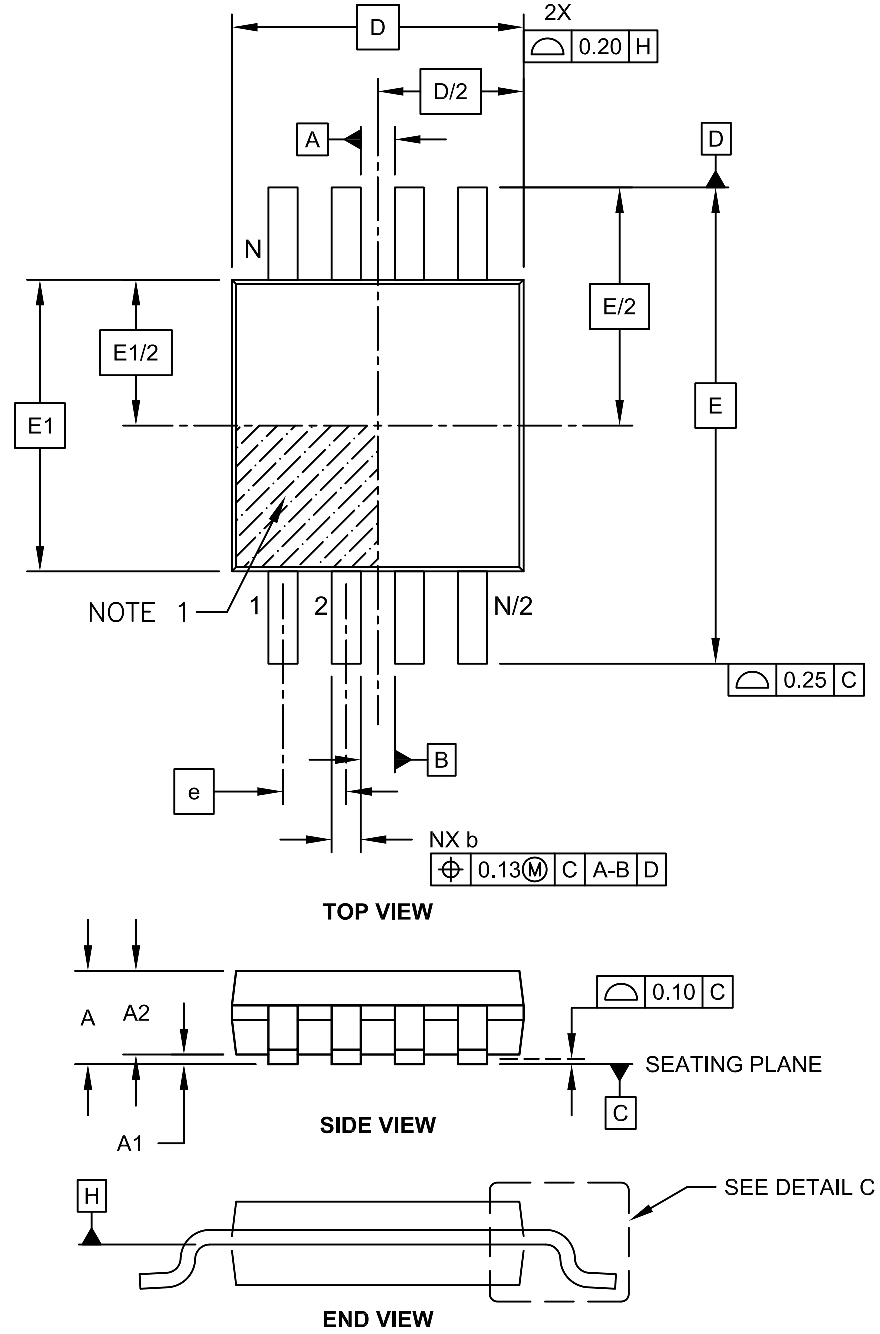


Legend:	XX...X	Customer-specific information
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week ‘01’)
	NNN	Alphanumeric traceability code
	ⓔ3	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator ⓔ3 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.

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

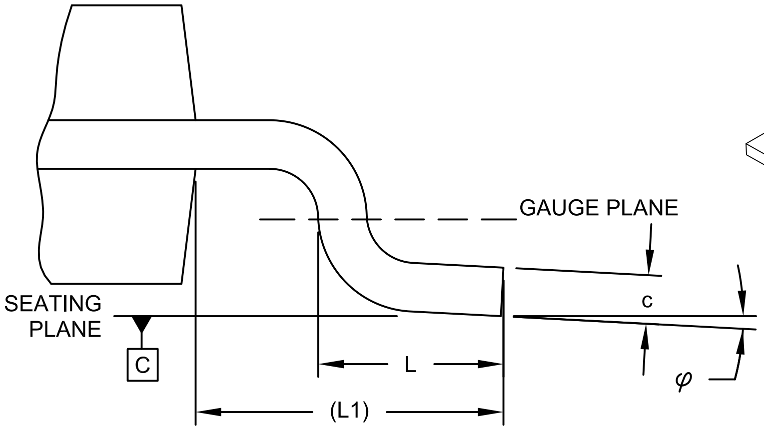
Note:	For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



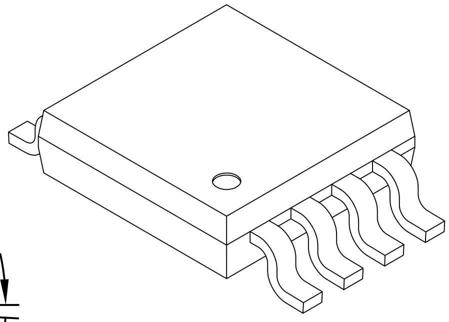
Microchip Technology Drawing C04-111C Sheet 1 of 2

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

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



DETAIL C



Units		MILLIMETERS		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		8	
Pitch	e	0.65 BSC		
Overall Height	A	-	-	1.10
Molded Package Thickness	A2	0.75	0.85	0.95
Standoff	A1	0.00	-	0.15
Overall Width	E	4.90 BSC		
Molded Package Width	E1	3.00 BSC		
Overall Length	D	3.00 BSC		
Foot Length	L	0.40	0.60	0.80
Footprint	L1	0.95 REF		
Foot Angle	φ	0°	-	8°
Lead Thickness	c	0.08	-	0.23
Lead Width	b	0.22	-	0.40

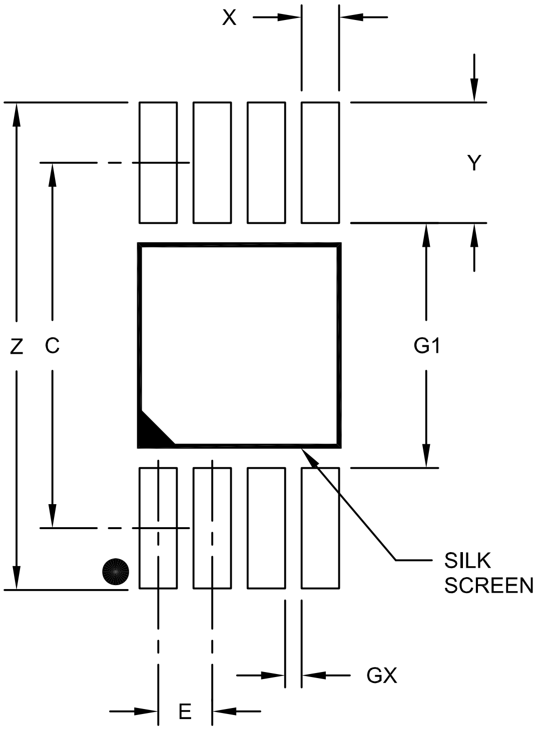
Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm per side.
3. 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 C04-111C Sheet 2 of 2

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

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		4.40	
Overall Width	Z			5.85
Contact Pad Width (X8)	X1			0.45
Contact Pad Length (X8)	Y1			1.45
Distance Between Pads	G1	2.95		
Distance Between Pads	GX	0.20		

Notes:

1. Dimensioning and tolerancing per ASME Y14.5M

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

Microchip Technology Drawing No. C04-2111A

APPENDIX A: REVISION HISTORY

Revision C (July 2014)

The following is the list of modifications:

1. Added the Extended Temperature (E) option and related information throughout the document.

Revision B (January 2013)

The following is the list of modifications:

1. Added a note to each package outline drawing.

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](1)	-XXX	X	/XX
Device	**Tape and Reel Option**	**Voltage Option**	**Temperature Range**	**Package**

MCP1252: Low-Noise, Positive-Regulated Charge Pump
MCP1252T: Low-Noise, Positive-Regulated Charge Pump (Tape and Reel)
MCP1253: Low-Noise, Positive-Regulated Charge Pump
MCP1253T: Low-Noise, Positive-Regulated Charge Pump (Tape and Reel)

Tape and Reel Option: T = Tape and Reel(1)

Output Voltage:
ADJ = Adjustable Voltage
33X50 = Selectable Voltage

Temperature Range:
I = -40°C to +85°C (Industrial)
E = -40°C to +125°C (Extended) (MCP1253 only)

Package: MS = Plastic Micro Small Outline (MSOP), 8-lead

Examples:

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

Note 1: Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

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ISBN: 978-1-63276-373-0

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