AN-2030 LMZ10503 / LMZ10504 Demo Board SIMPLE SWITCHER® Power Module Quick Start Guide

1 Introduction

The LMZ10503/4 SIMPLE SWITCHER power module is a complete, easy-to-use DC-DC solution capable of driving up to a 4A load with exceptional power conversion efficiency, output voltage accuracy, line and load regulation. The LMZ10503/4 is available in an innovative package that enhances thermal performance and allows for hand or machine soldering.

The LMZ10503/4 can accept an input voltage rail between 2.95V and 5.5V and deliver an adjustable and highly accurate output voltage as low as 0.8V. One megahertz fixed frequency PWM switching provides a predictable EMI characteristic. Two external compensation components can be adjusted to set the fastest response time, while allowing the option to use ceramic and/or electrolytic output capacitors. Externally programmable soft-start capacitor facilitates controlled startup. The LMZ10503/4 is a reliable and robust solution with the following features: lossless cycle-by-cycle peak current limit to protect for over current or short-circuit fault, thermal shutdown, input under-voltage lock-out, and pre-biased startup.

2 Packaging Highlights

- Single exposed pad and standard pin out for easy mounting and manufacturing
- 10.2 x 13.8 x 4.6 mm (0.4 x 0.39 x 0.18 in) package
- 20W maximum total output power
- 1.7” x 2.3” (4.3 cm x 5.8 cm) reduced size demo board form factor

3 Demo Board Features

- Power input voltage range 2.95V-5.5V
- Input UVLO at 2.7V
- Adjustable output voltage range 0.8V to 5V
- Up to 4A output current (LMZ10504)
- Up to 3A output current (LMZ10503)
- Integrated shielded inductor in module
- Efficiency up to 96% at 1A load
- All ceramic capacitor design
- Partial compensation allows adjustment of the control loop
- Starts into pre-biased loads
- ±1.63% maximum feedback voltage accuracy over temperature
- ±2.5% maximum feedback voltage accuracy over full line, load, and temperature conditions
- Thermal Shutdown
- Only 9 external passives plus module
- Two layer low cost assembly

4 Typical Applications

- Point-of-load conversions from 3.3V and 5V rails
- Space constrained applications
- Extreme temperatures/no air flow environments
- Noise sensitive applications (i.e. transceiver, medical)
- Industrial controls
- Networking equipment

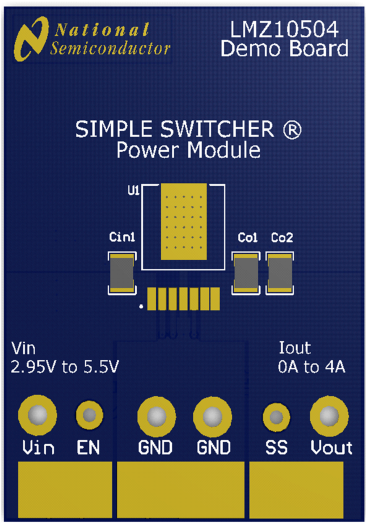

Figure 1. Top Layer

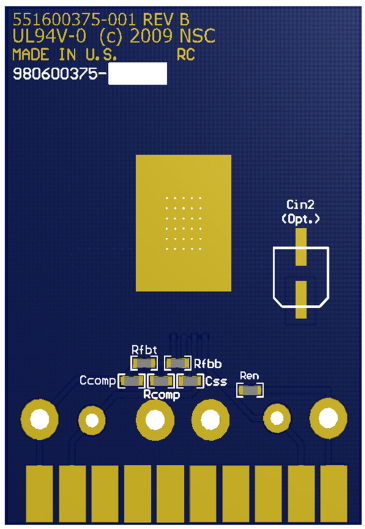

Figure 2. Bottom Layer

Table 1. Absolute Maximum Module Ratings

VIN to GND	-0.3V to 6V
EN, FB, SS to GND	-0.3V to 6V

Table 2. Module Operating Ratings

VIN	2.95V to 5.5V
Junction Temperature Range (T_J)	-40°C to +125°C

Table 3. Demo Board Operating Ratings

V_{IN}	2.95V to 5.5V
V_{OUT}	2.5V
I_{OUT}	0A to 4A or 0A to 3A
Softstart time	4 ms
Operating Ambient Temperature Range (T_A)	- 40°C to +94°C (at full 4A load)
θ_{JA}	30°C/W
θ_{JC}	1.9°C/W
Board Dimensions	1.7 x 2.3 (4.3 cm x 5.8 cm)
Number of Layers	2

5 Demo Board Schematic

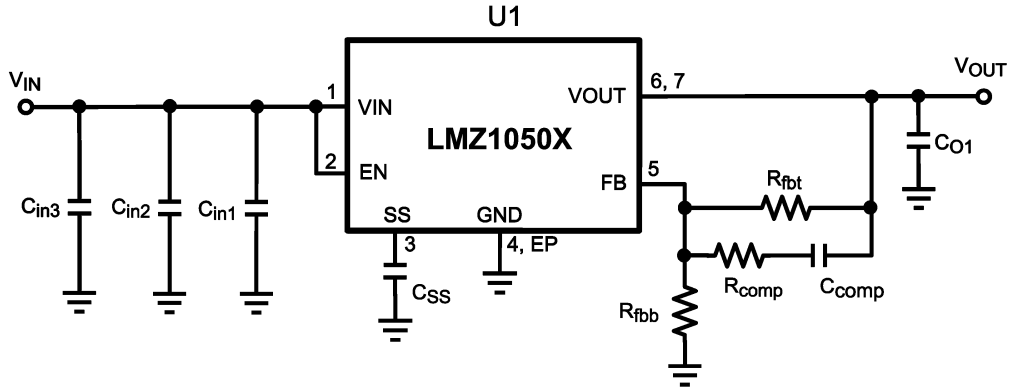

Table 4. Demo Board Bill of Materials

Ref Des	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER	TO-PMOD	Texas Instruments	LMZ10503/4	1
C_{in1}, C_{o1}, C_{o2}	47 µF, X5R, 16V	1206	TDK	C3216X5R1C476M	3
C_{in2}	220 µF, 10V, AL-Elec	E	Panasonic	EEE-FPA221XAP	0 (1)
C_{comp}	120 pF, 5%, C0G, 50V	0603	TDK	C1608C0G1H121J	1
C_{ss}	10 nF, 5%, C0G, 25V	0603	TDK	C1608C0G1E103J	1
R_{fbt}	75 kΩ	0603	Vishay Dale	CRCW060375K0FKEA	1
R_{fbb}	34.8 kΩ	0603	Vishay Dale	CRCW060334K8FKEA	1
R_{comp}	1.1 kΩ	0603	Vishay Dale	CRCW06031K10FKEA	1
R_{en}	100 kΩ	0603	Vishay Dale	CRCW0603100KFKEA	1
VIN, GND, VOUT	Turret Terminal	1502-2	Keystone	1502-2K-ND	4
EN, SS	Turret Terminal	1593-2	Keystone	1593-2K-ND	2

(1) Not installed

Table 5. Output Voltage Setting (R_{fbt} = 75 kΩ)

V_{OUT}	R_{fbb}
3.3 V	23.7 kΩ
2.5 V	34.8 kΩ
1.8 V	59 kΩ
1.5 V	84.5 kΩ
1.2 V	150 kΩ
0.9 V	590 kΩ

6 Demo Board Hookup

VOUT Connect the load to VOUT and one of the GND posts. The module can source up to a 3A or 4A load current, depending on the module installed.

VIN Connect VIN to a positive voltage in the 2.95 to 5.5V range. Connect the negative terminal of the source supply to one of the posts labeled GND.

EN The enable is configured with a 100 kΩ pull up resistor, which enables the LMZ10503/4, but also allows the user to disable the LMZ10503/4, by pulling low on the EN post.

Quiescent current If the enable post is pulled low, the module will be disabled and about 260 µA of supply current will flow into VIN (pin 1). To enable the device, leave the enable post open, there will be approximately 12 mA of no-load quiescent current into the VIN post. (VIN to ground voltage at the post set to 3.3V).

7 Demo Board Passive Components

Soft-start capacitor The soft-start capacitor controls the rise time of the output voltage when power is first applied and following the clearing of a fault mode.

Feedback divider Regulator output voltage is programmed though the selection of the two resistors, R_{fbb} and R_{fbt}. C_{comp} R_{comp} is located in parallel with the upper feedback divider resistor, R_{fbt}. These components adjust the control loop and will improve the step response to abrupt changes in load current and input voltage.

Output Capacitor Parallel connections of two 47 µF 6.3V multilayer ceramic are used for the output capacitor.

Input Capacitor A 47 µF 16V multilayer ceramic (C_{in1}) supplies the fast switching current generated from the quick rise time of the internal MOSFET. C_{in1} is also the energy reservoir for the input line. Additionally, C_{in2} is not installed, but is a placeholder for an aluminum capacitor to reduce the resonance of the input line produced by the inductance and resistance in the cables connecting the bench power supply to the evaluation board and the input capacitors.

8 Performance Characteristics

The following curves apply to the LMZ10504 demo board.

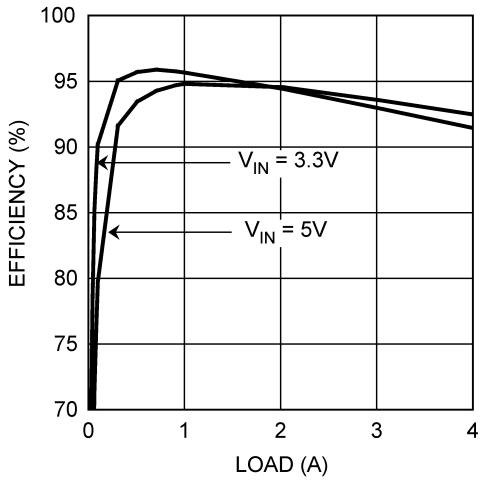

Figure 3. Efficiency, V_{OUT} = 2.5V, T_{AMB} = 25°C

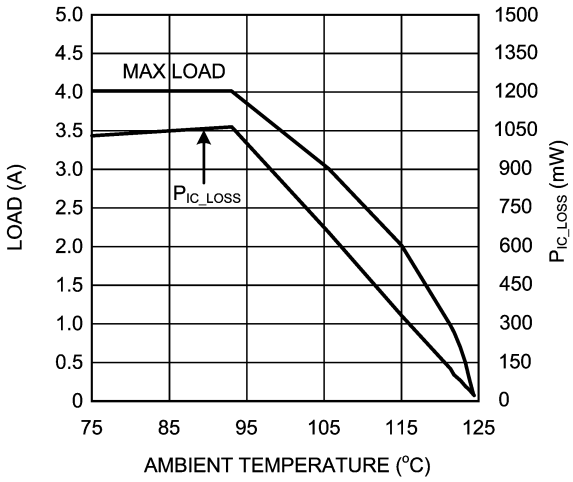

Figure 4. Current Derating
V_{OUT} = 3.3V, V_{OUT} = 2.5V, θ_{JA} = 30°C/W

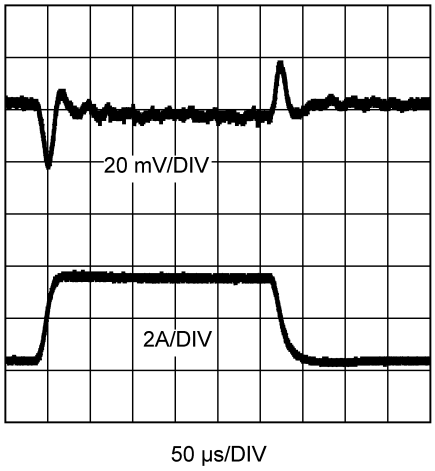

Figure 5. Load Transient Response
V_{OUT} = 5V, V_{OUT} = 2.5V, I_{OUT} = 0.4A to 3.6A step
20 mV/DIV, 20 MHz Bandwidth Limited

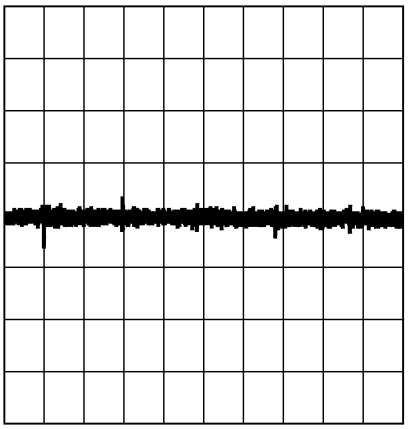

Figure 6. Output Voltage Ripple
V_{OUT} = 3.3V, V_{OUT}= 2.5V, I_{OUT} = 4A, 20 mV/DIV

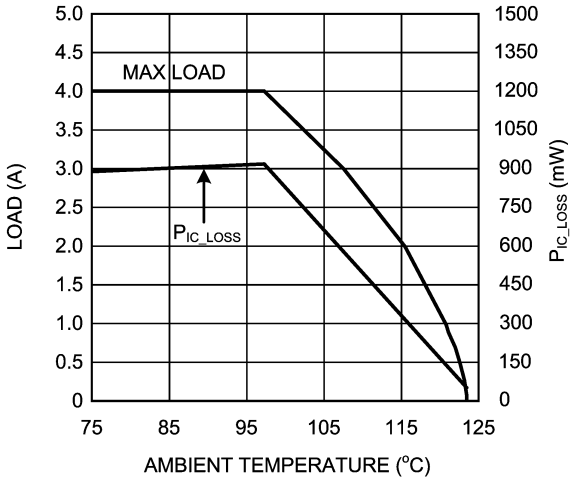

Figure 7. Current Derating
V_{IN} = 5.0V, V_{OUT} = 2.5V, θ_{JA} = 30°C/W

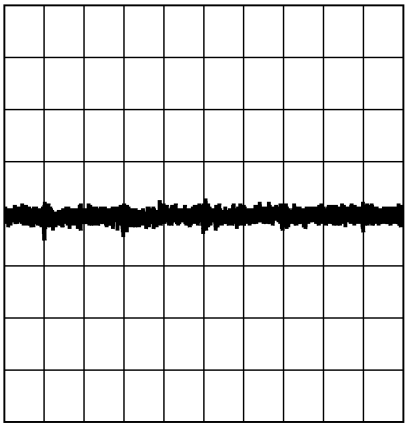

Figure 8. Output Voltage Ripple
V_{IN} = 5V, V_{OUT} = 2.5V, I_{OUT} = 4A, 20 mV/DIV

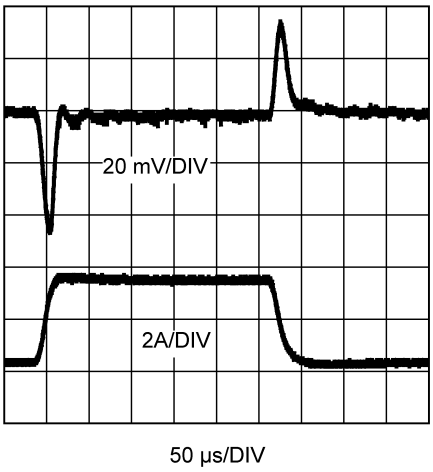

Figure 9. Load Transient Response
V_{IN} = 3.3V, V_{OUT}= 2.5V , I_{OUT} = 0.4A to 3.6A step
20 mV/DIV, 20 MHz Bandwidth Limited

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