

# **AN-2031 LMZ12003 3A Demo Board SIMPLE SWITCHER® Power Module Quick Start Guide**

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## **1 Description**

The LMZ12003 SIMPLE SWITCHER power module is a complete, easy to use step-down DC-DC solution capable of driving up to 3A load. The LMZ12003 is available in an innovative, easy to use package that enhances thermal performance and allows for hand or machine soldering.

The LMZ12003 demo board can accept an input voltage rail between 4.5V and 20V and deliver an adjustable and highly accurate output voltage as low as 0.8V. The LMZ12003 only requires three external resistors and four external capacitors to complete the power solution. The LMZ12003 is a reliable and robust solution with the following protection features: thermal shutdown, input under-voltage lockout (UVLO), output over-voltage protection (OVP), short-circuit protection, output current limit, and allows startup into a pre-biased output. A single resistor adjusts switching frequency up to 1 MHz.

## **2 Packaging Highlights**

- 7 lead module package (Similar to TO-263)
- Single exposed die attach pad for enhanced thermal performance
- 10.2 x 13.8 x 4.6 mm module package
- High power density
- 1.7" x 2.3" reduced size demo board form factor

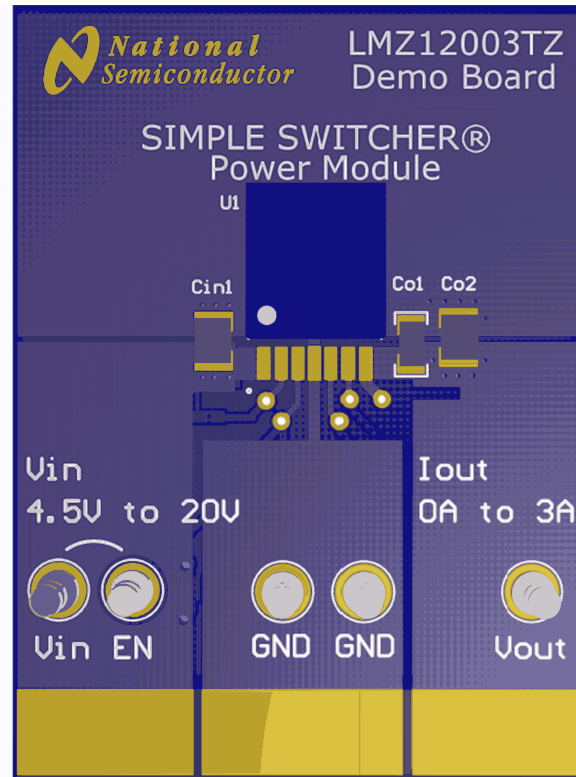
## **3 Demo Board Features**

- Power input voltage range 4.5V-20V
- UVLO programmed at 4.5V
- Adjustable output voltage range 0.8V to 6V
- Up to 3A output current
- Integrated shielded inductor in module
- Efficiency up to 92%
- All ceramic capacitor design
- No loop compensation required
- Starts into pre-biased loads
- Short circuit protection
- Thermal shutdown
- Only 9 external passives plus module
- 2 layer low cost assembly

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#### 4 Typical Applications

- Point of load conversions from 5V and 12V input rails
- Space constrained applications
- Industrial controls
- Telecom
- Networking equipment



**Figure 1. Front View**

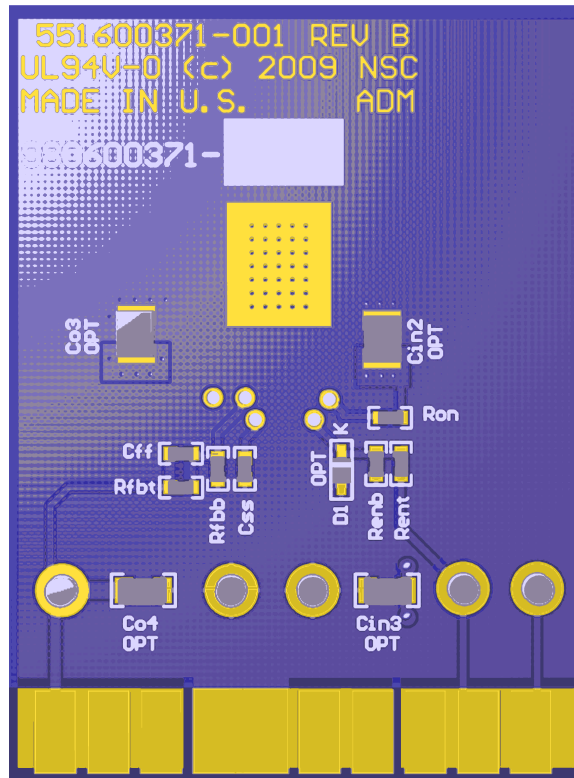


Figure 2. Back View

Table 1. Absolute Maximum Module Ratings

VIN, RON to GND	-0.3V to 25V
EN, FB, SS to GND	-0.3V to 7V

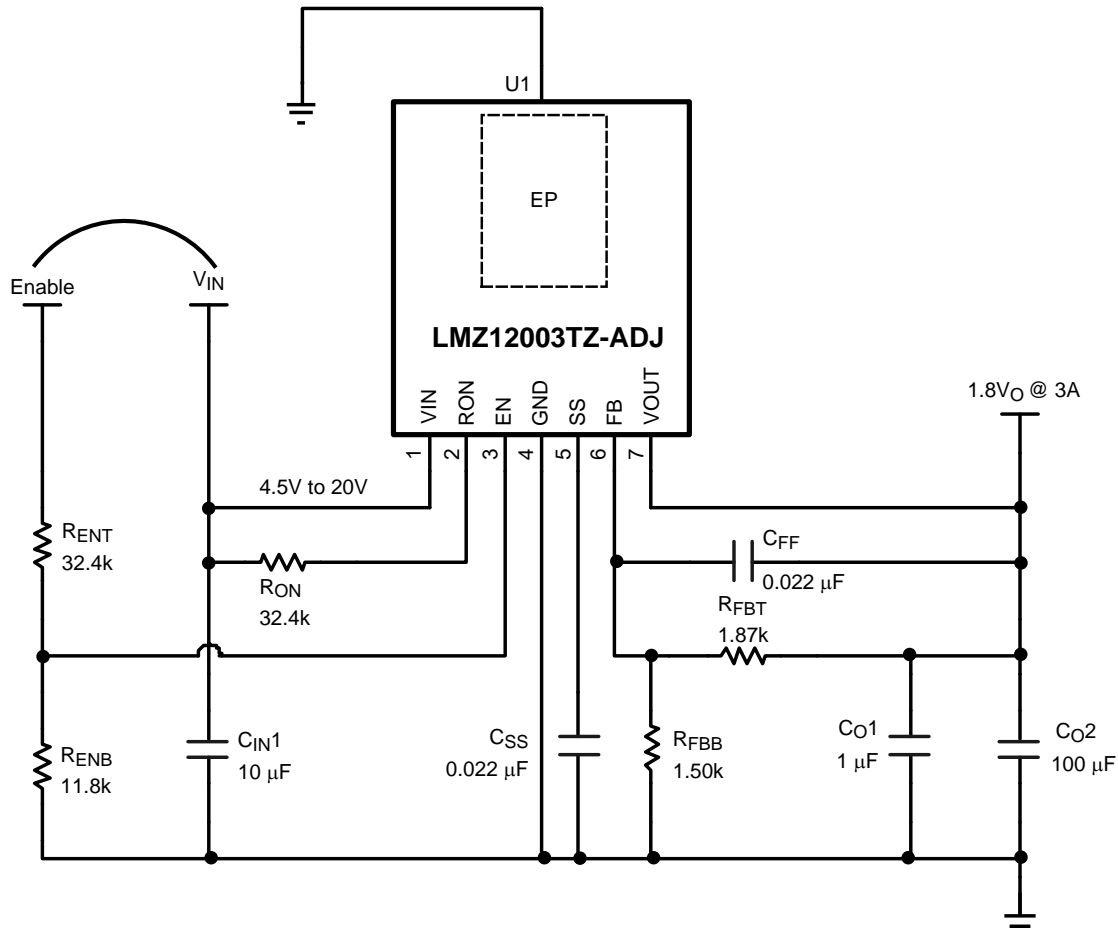
Table 2. Module Operating Ratings

VIN	4.5V to 20V
EN (Input on pin 3 module pin)	0V to 6.5V
Junction Temperature Range (Tj)	- 40C to +125C

Table 3. Demo Board Operating Ratings

VIN	4.5V to 20V
VOUT (Default setting)	1.8V
IOUT	0A to 3A
EN (Input on demo board post)	0V to 20V
UVLO setting on ENable input	4.5V
Soft-start time	2.2 mSec
Operating Temperature Range (Tj)	- 40C to +70C (at full 3A load)

## 5 Demo Board Schematic



## 6 Demo Board Bill of Materials (BOM)

**Table 4. Board Bill of Materials (BOM)**

Ref Des	Description	Case	Manufacturer Part Number
Ron	32.4 kohm 1% resistor	603	
Rent	32.4 kohm 1% resistor	603	
Renb	11.8 kohm 1% resistor	603	
Rfbt	1.87 kohm 1% resistor	603	
Rfbb	1.50 kohm 1% resistor	603	
Cff	0.022 uF 50V X7R ceramic capacitor	603	
Css	0.022 uF 50V X7R ceramic capacitor	603	
Cin	10 uF 50V X5R ceramic capacitor	1210	UMK325BJ106MM-T
Cout1	1.0 uF 50V X7R ceramic capacitor	1206	UMK316B7105KL-T
Cout2	100 uF 6.3V X5R ceramic capacitor	1210	JMK325BJ107MM-T
U1	LMZ12003 SIMPLE SWITCHER Power Module	TO-PMOD	LMZ12003TZ-ADJ

**Table 4. Board Bill of Materials (BOM) (continued)**

Ref Des	Description	Case	Manufacturer Part Number
<b>Alternate resistor values for alternative output voltages</b>			
VOUT	RFBT	RFBB	RON
6	2.49k	383 Ω	124k
5	5.62k	1.07k	100k
3.3	3.32k	1.07k	61.9k
2.5	2.26k	1.07k	47.5k
1.8	1.87k	1.50k	32.4k
1.5	1.00k	1.13k	28.0k
1.2	4.22k	8.45k	22.6k
0.8	0.0K	39.2k	24.9k

## 7 Demo Board Hookup

**VOUT** Connect the load to  $V_{OUT}$  and one of the GND posts. The module can source up to a 3A load current.

Connect VIN to a positive voltage in the 4.5 to 20V range. Connect the negative terminal of the source supply to one of the posts labeled GND.

The Enable input post is configured for direct connection to the Vin post. With the chosen resistor values this results in an under voltage lockout level of 4.5V input. The top enable resistor is RENT (aka REN1) and the bottom enable resistor is RENB (aka REN2).

If the Enable post is disconnected, the module will be disabled and about 20 uA of supply current will flow from Vin to ground while in the disabled mode. With the enable input connected to Vin via the resistor divider there will be about 1.5 mA of no-load quiescent current into the Vin input. Additional current flows into the enable divider string.

## 8 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.

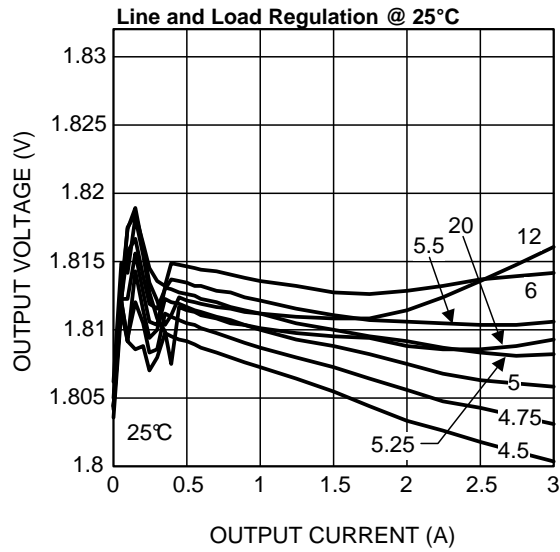
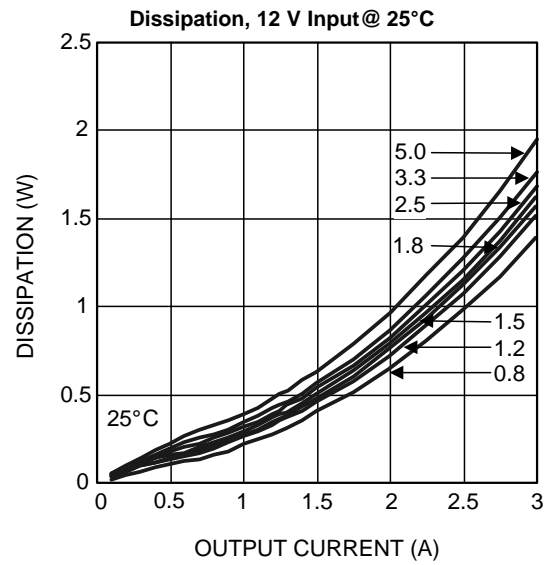
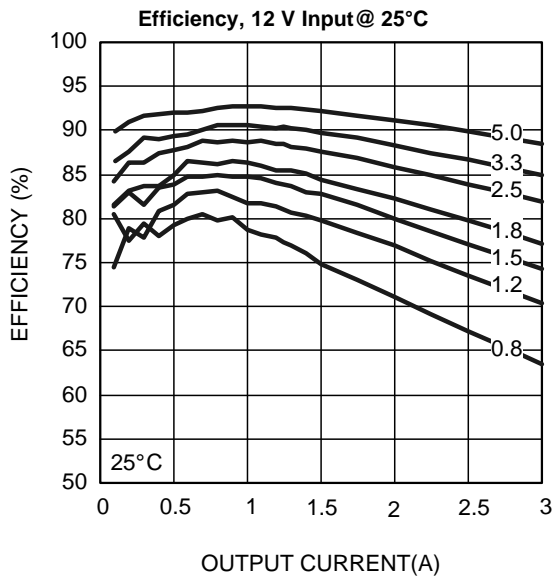
**Feedback divider:** Regulator output voltage is programmed through the selection of the two resistors. RFBT ( aka RFB1)and RFB (aka RFB2) A feed forward capacitor (CFF) is located in parallel with the upper feedback divider resistor. This capacitor improves the step response to abrupt changes in load current. For a different output voltage, see [Table 4](#) when modifying the board. Resistor values shown will minimize error in output voltage setting.

**RON Resistor:** The primary function of the RON resistor is to set the On-Time interval of the internal control section switching cycle. The secondary function of the RON resistor is to create a nearly constant operating frequency over the input operating voltage range. If the output voltage of the regulator is changed by adjusting the feedback divider then it is generally required that the RON resistor value also be changed in order to maintain the same operating frequency.

**Cout:** A parallel connection of a 1 μF 50V and a 100 μF 6.3V multilayer ceramic are used for the output capacitor. Locations are provided on the PCB assembly for experimenting with additional output capacitors..

**Cin:** A 10 uF 50V multilayer ceramic is connected as the input filter. Locations are provided on the PCB assembly for experimenting with additional input capacitors.

## 9 Performance Characteristics



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