AN-2166 LMZ10501 and LMZ10500 SIMPLE SWITCHER® Nano Module Evaluation Board

1 Introduction

The LMZ10501 and LMZ10500 SIMPLE SWITCHER nano modules are easy-to-use DC-DC solutions optimized for space-constrained applications. The LMZ10501 is capable of driving up to 1A load with excellent power conversion efficiency, line and load regulation, and EMI performance. The LMZ10500 is a 650mA version module and is pin-to-pin compatible with the LMZ10501.

The LMZ10501 and LMZ10500 Evaluation Board is configured for 1.8V output voltage from 2.7V to 5.5V input. The resistor voltage divider R_T and R_B set the output voltage. The external capacitor C_{VC} bypasses the V_{CON} pin and provides additional soft start time. for component selection and device information details, see the device-specific data sheet. The board features additional component footprints for various device enabling schemes and AC signal injection terminals for feedback loop measurements.

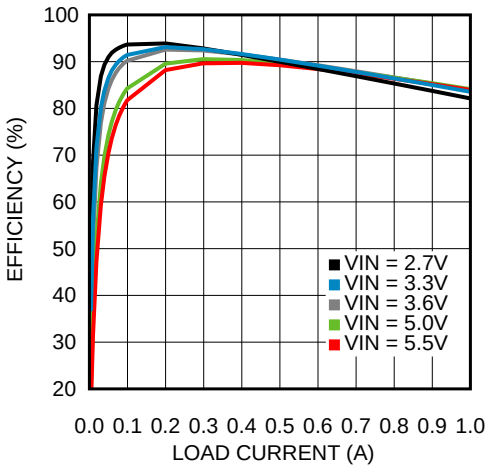
The evaluation board with its default Bill of Materials offers great EMI performance, complying with the EN 55022 Class B radiated emissions standard.

2 Board Specifications

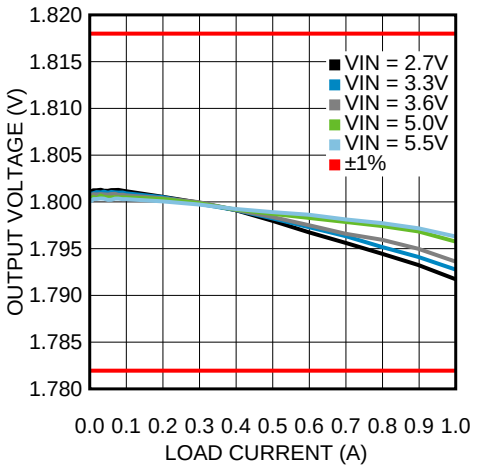
- V_{IN} = 2.7V to 5.5V
- V_{OUT} = 1.8V (default setting)
- 1A max load (LMZ10501)
- 650mA max load (LMZ10500)
- 2MHz switching frequency
- 4 layers PCB with 1oz copper
- 4.3 x 4.3 cm (1700 x 1700 mil) PCB size
- Low radiated EMI (EN 55022 Class B compliant)

3 Typical Performance Characteristics

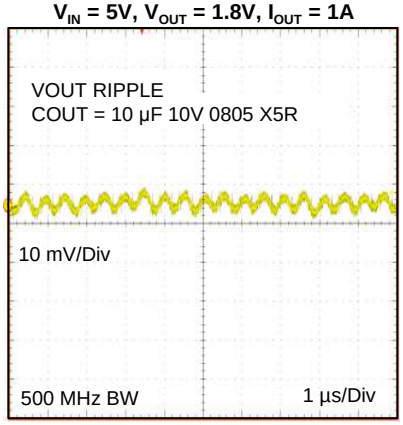
Efficiency V_{OUT} = 1.8V



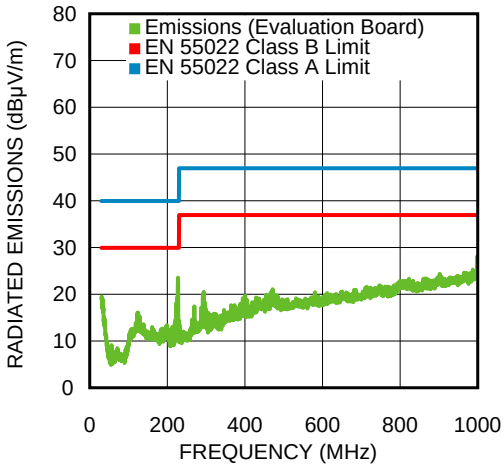
Line and Load Regulation



Output Ripple
V_{IN} = 5V, V_{OUT} = 1.8V, I_{OUT} = 1A



Radiated EMI
V_{IN} = 5V, V_{OUT} = 1.8V, I_{OUT} = 1A



4 Evaluation Board Schematic and Bill of Materials

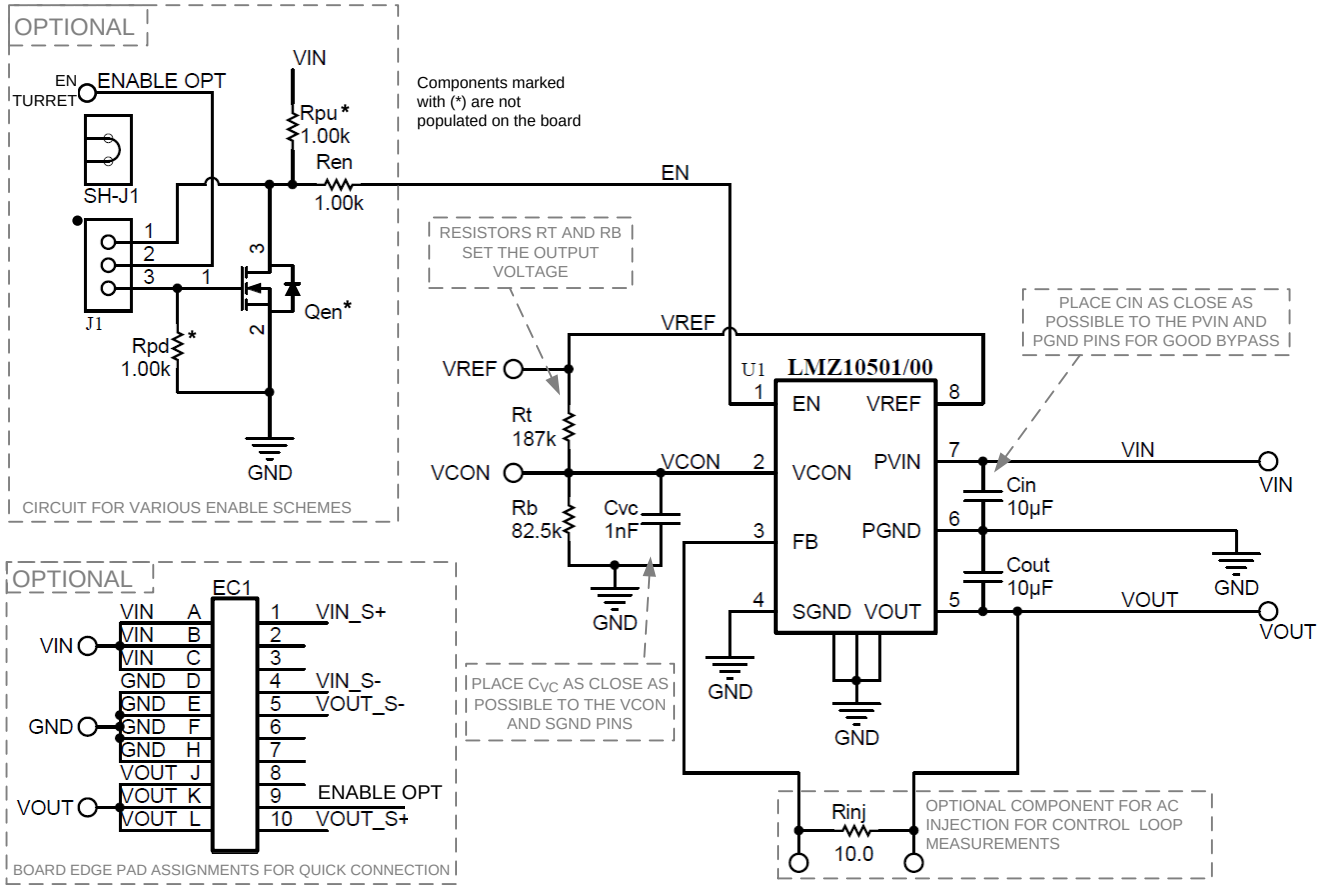


Figure 1. Evaluation Board Schematic

Table 1. LMZ10501 and LMZ10500 Bill of Materials, V_{IN} = 2.7V to 5.5V, V_{OUT} = 1.8V, $I_{OUT\ (MAX)}$ = 1000mA / 650mA

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER Nano Module	SE08A	Texas Instruments	LMZ10501SE or LMZ10500SE	1
C_{IN}, C_{OUT}	10 µF, X5R, 10V	0805	KEMET	C0805C106K8PACTU	2
C_{VC}	1000 pF	0603	TDK	C1608C0G2A102J	1
R_B	82.5 kΩ	0603	Vishay-Dale	CRCW060382K5FKEA	1
R_T	187 kΩ	0603	Vishay-Dale	CRCW0603187KFKEA	1
R_{EN} (optional)	1 kΩ	0603	Vishay-Dale	CRCW06031K00FKEA	1
R_{INJ} (optional)	10 Ω	0603	Vishay-Dale	CRCW060310R0FKEA	1

4.1 Optional Components and Footprints

- R_{INJ} resistor – allows for a network analyzer connection to measure the control loop response. Replace this resistor with a short in a final design if control loop measurements are not needed.
- R_{PU} resistor – an optional footprint to pull EN up to V_{IN} with an external resistor. EN is internally pulled up to V_{IN} by a 790 kΩ resistor.
- R_{EN} – an optional resistor in series with the EN pin.
- R_{PD} – an optional pull-down resistor for the Q_{EN} gate.
- Q_{EN} – an optional footprint to use an N-ch MOSFET as a pull-down device for EN.
- J1 – jumper to select how to drive EN. Connecting the jumper pins 1 and 2 allows for driving EN directly from the EN turret at the edge of the board. Connecting the jumper pins 2 and 3 allows for driving the gate of the pull-down device Q_{EN}.
- EC1 – board edge connector for quick testing.
- C_{OUT} footprints – the solder mask on the V_{OUT} side of the board is removed to allow for different output capacitor configurations.

5 Evaluation Board Layout

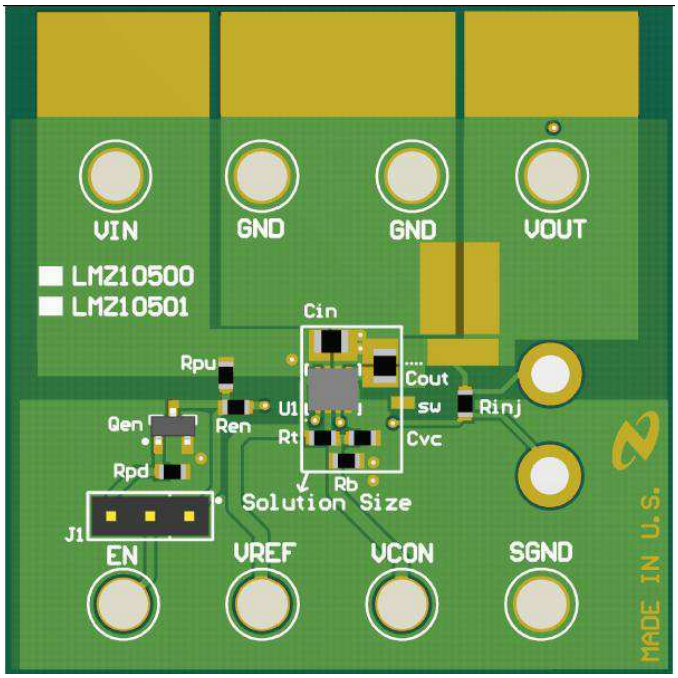


Figure 2. Evaluation Board Top View

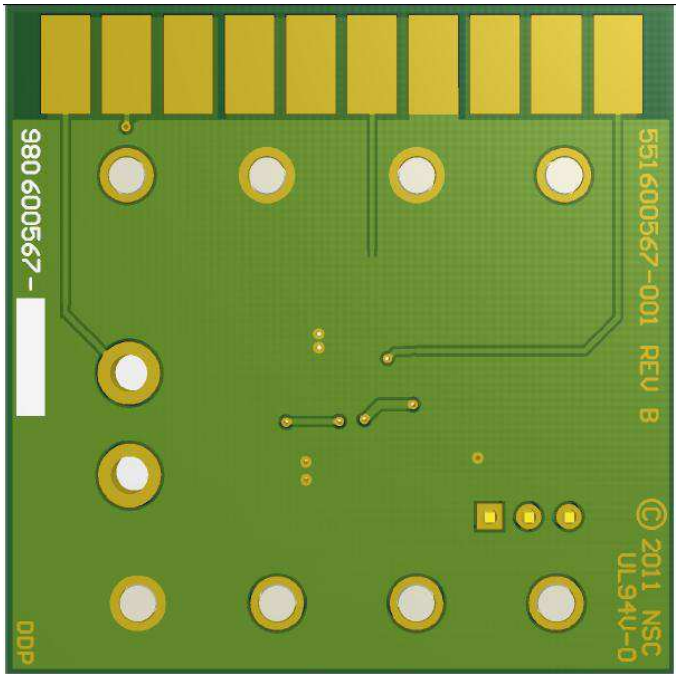


Figure 3. Evaluation Board Bottom View

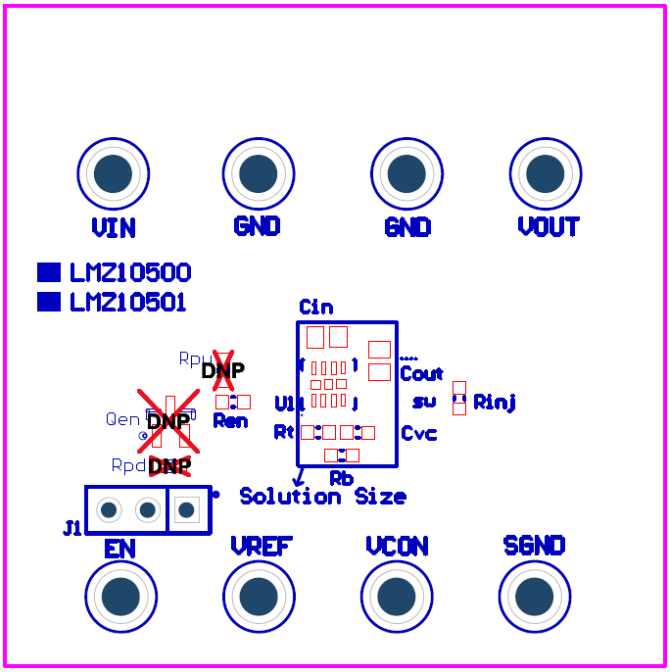
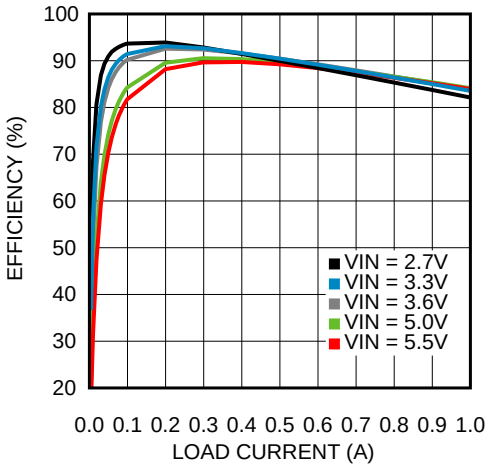


Figure 4. Evaluation Board Assembly (DNP = not populated components)

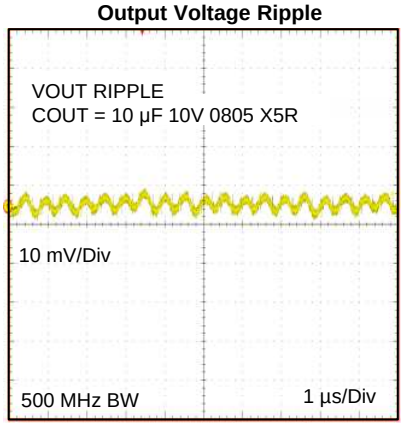
6 Typical Performance for V_{OUT} = 1.8V

Unless otherwise specified the following conditions apply: V_{IN} = 5V, I_{OUT} = 1A, T_A = 25°C

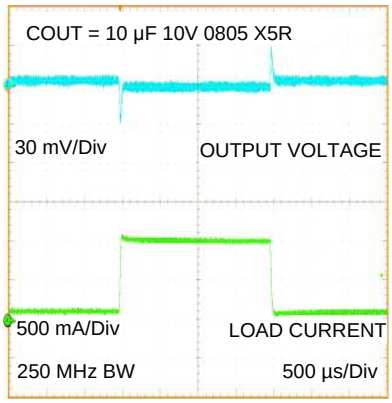
Efficiency



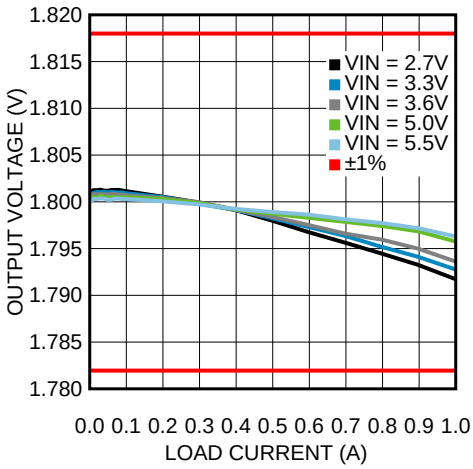
Output Voltage Ripple



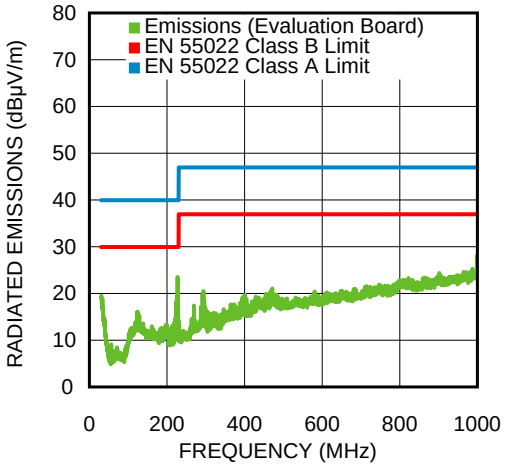
Load Transient Response



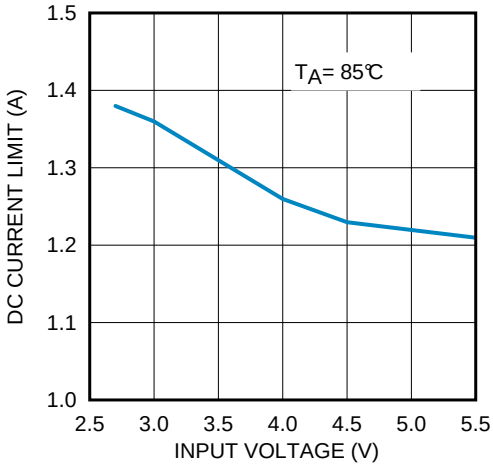
Line and load regulation



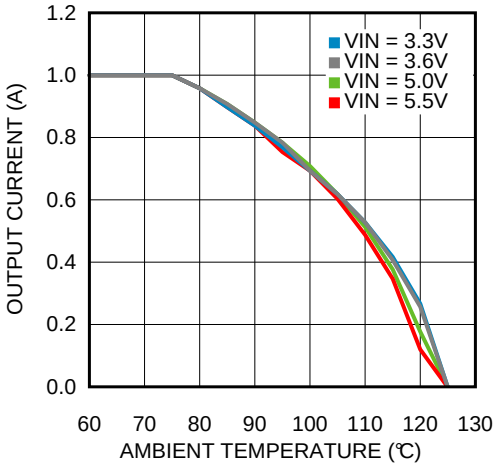
Radiated EMI



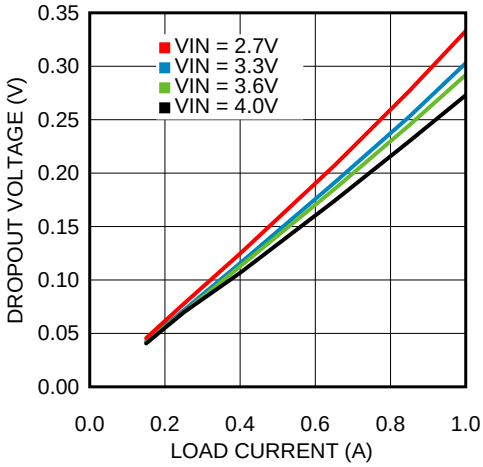
DC Current Limit



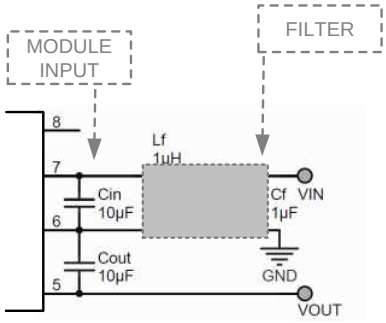
Thermal Derating



Dropout Voltage

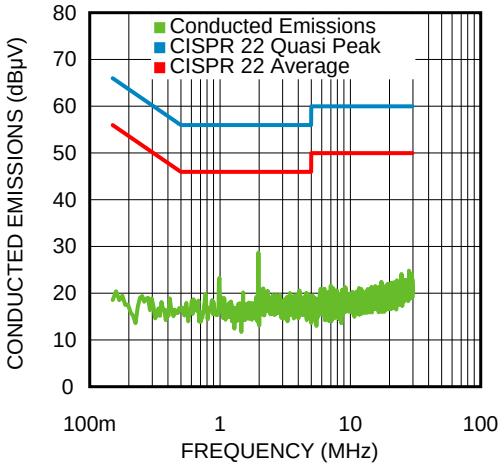


Input LC Filter for Conducted EMI

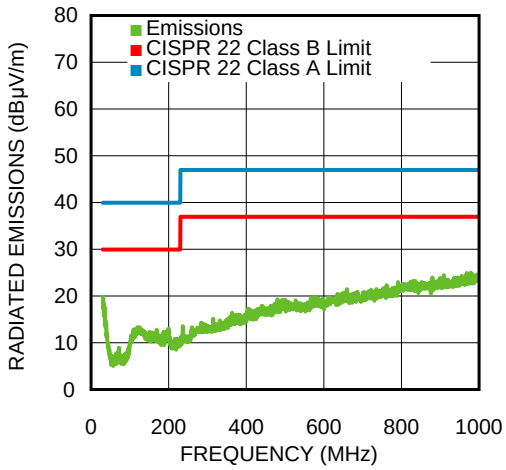


Cf = 0603YD105MAT AVX
Lf = VLS252015T-1R0N1R7 TDK

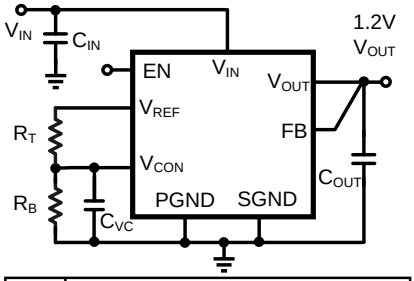
Conducted EMI with the Input LC Filter



Radiated EMI with the Input LC Filter

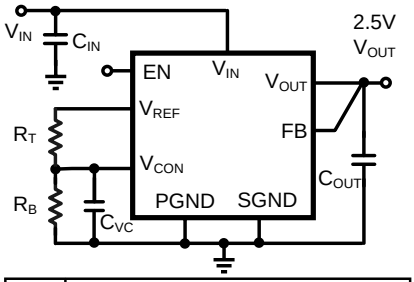


7 Other Output Voltage Settings



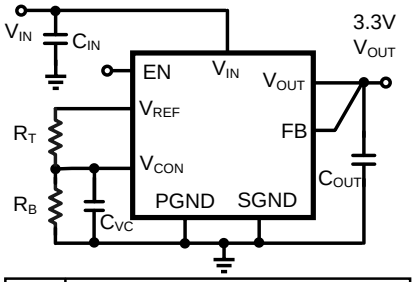
C_{IN}	10 µF	≥ 6.3V	0805	X7R or X5R
C_{OUT}	10 µF	≥ 6.3V	0805	X7R or X5R
C_{VC}	470 pF	≥ 6.3V	0603	X7R or X5R
R_T	243 kΩ	1%	0603	
R_B	63.4 kΩ	1%	0603	

Figure 5. V_{OUT} = 1.2V



C_{IN}	10 µF	≥ 6.3V	0805	X7R or X5R
C_{OUT}	10 µF	≥ 6.3V	0805	X7R or X5R
C_{VC}	470 pF	≥ 6.3V	0603	X7R or X5R
R_T	150 kΩ	1%	0603	
R_B	118 kΩ	1%	0603	

Figure 6. V_{OUT} = 2.5V



C_{IN}	10 µF	≥ 6.3V	0805	X7R or X5R
C_{OUT}	10 µF	≥ 6.3V	0805	X7R or X5R
C_{VC}	470 pF	≥ 6.3V	0603	X7R or X5R
R_T	118 kΩ	1%	0603	
R_B	150 kΩ	1%	0603	

Figure 7. V_{OUT} = 3.3V

For other output voltages, choose R_T = 80kΩ to 300kΩ

Then calculate R_B using

$$\mathbf{R_B = V_{OUT} \times R_T / (5.875V - V_{OUT})} \quad (1)$$

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