LM3152-3.3 Demonstration Board

National Semiconductor
RD-164
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1.0 Design Specifications

Inputs	Output #1
VinMin=6V	Vout1=3.3V
VinMax=24V	Iout1=10A

2.0 Design Description

The LM3152-3.3 demonstration board is part of the PowerWise® family of SIMPLE SWITCHER® Controllers. It has been designed to balance solution size and performance. The Constant-On-Time (COT) Emulated Ripple Mode (ERM) Control allows for the use of low ESR output capacitors and therefore decreases the output voltage ripple while maintaining a fast transient response. There is no loop compensation required for the COT architecture, as there is in voltage-mode and current mode control architectures, which helps to facilitate the ease of design and fast transient response. The demo board uses a 2-layer, 2 ounce copper PCB with all of the components mounted on the top side. The LM3152-3.3 IC has a fixed output voltage of 3.3V and will operate over the input voltage range of 6V to 24V at 10A load current. The components within the dashed line of the board photo in Figure 3, represent the total design solution. The aluminum electrolytic input capacitor Cin1 is used for input filter damping when using long leads, which contributes to parasitic inductance in the lab while using the demo board. Cin1 along with the input/output posts and EN test point connector may not be needed when the final circuit is integrated in the system design.

3.0 Features

- Easy To Use with Webench and Offline Design Tools
- No Loop Compensation Required
- Low Solution Component Count
- Ultra-Fast Transient Response
- Low Output Voltage Ripple (32mVpp)
- 3.3V Fixed Output Voltage
- Optimized for 10A Average Load Current
- 95% Peak Efficiency
- Constant-On-Time with Emulated Ripple Mode Control
- 500kHz Switching Frequency

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4.0 Schematic

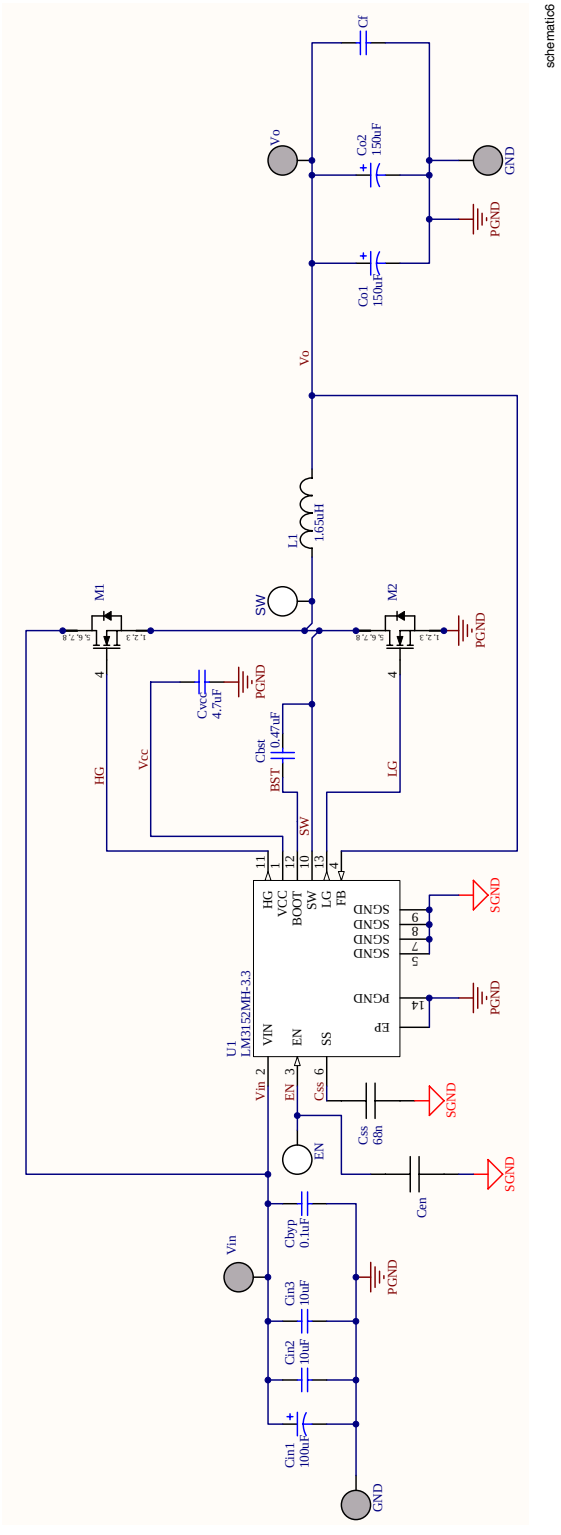


FIGURE 1. LM3152-3.3 Demo Board Schematic

Designator	Manufacturer	Part Number	Value	Parameters
U1	National Semiconductor	LM3152MH-3.3		Simple Controller
Cbst	TDK	C2012X7R1C474K	0.47uF	Ceramic, 0805, X7R, 16V, 10%
Cbyp	TDK	C2012X7R1H104K	0.1uF	Ceramic, 0805, X7R, 50V, 10%
Cen	TDK	C1005X7R1H102K	1000pF	Ceramic, 0402, X7R, 50V, 10%
Cf				Not Fitted
Cin1	Panasonic	EEV-FK1J101P	100uF	AL, EEV-FK, 63V, 20%
Cin2, Cin3	Taiyo Yuden	GMK325BJ106KN-T	10uF	Ceramic, 1210, X5R, 35V, 10%
Co1, Co2	Panasonic	EEF-UE0J151R	150uF	Polymer AL, UE, 6.3V, 20%
Css	AVX	0603YC683KAT2A	0.068uF	Ceramic, 0603, X7R, 16V, 10%
Cvcc	MuRata	GRM21BR71C475KA73L	4.7uF	Ceramic, 0805, X7R, 16V, 10%
L1	Coilcraft Inc.	HA3778-AL	1.65uH	Shielded Drum Core, 17A, 2.53mΩ
M1, M2	Renesas	RJK0305DB	30V	LFPAK, 30Vds, N-MOSFET

bom3

FIGURE 2. Bill of Materials

6.0 Other Operating Values

Operating Values

Description	Parameter	Value	Unit
Switching Frequency	Frequency	500	KHz
Max Average Load Current	Iout	10	A
Max Steady State Efficiency	Efficiency	95	%
Control Scheme	Control Scheme	COT	
Peak-to-Peak Output Ripple Voltage	Voutp-p	32	mV
Minimum Input Voltage	Vinmin	6	V
Maximum Input Voltage	Vinmax	24	V

7.0 Board Photos



FIGURE 3. LM3152-3.3 Demo Board Photo

8.0 Quick Start

CONNECTOR POSTS DESCRIPTIONS

Vin: This post is used to connect to the input voltage supply rail. Input voltage ranges between 6V and 24V and the max nominal input current is 6A. Appropriate leads should be connected to this terminal that can handle this amount of input current plus fault conditions which could have input currents as high 10A peak. Therefore, it is recommended to use 16 gauge wire as a minimum for the input leads.

GND: There are two GND posts which are connected to the ground of the IC. One should be used for the input voltage supply and the other should be used for the output voltage. The GND post closest to the input supply post Vin should be used for the input supply ground, and likewise the GND post closest to the output post Vo should be used for the Vo ground. For the Vin ground connector lead it is recommended to use 16 gauge wire or larger. Whereas the output ground connector lead is recommended to use 15 gauge wire or larger.

Vo: This post connects to the output voltage of the LM3152-3.3 Simple Controller. When connecting the load to this post, it is recommended to use 15 gauge wire or larger. The max average load current is designed for 10A with a current limit of 15A using the Rdson of the low side FET to set the current limit trip point.

EN: This post is connected to the enable pin of the LM3152-3.3 IC. When left floating a 1MΩ pull-up resistor to Vin will enable the device.

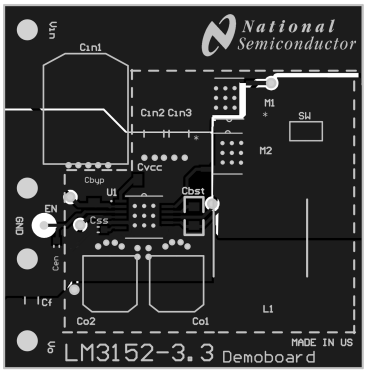
MEASURING RIPPLE

To get an accurate measurement of the output ripple voltage it is necessary to eliminate the long pig-tale from the scope probe and use a short ground connector or just the shaft of the barrel to connect to ground. This will minimize parasitic inductance from the scope probe and allow for a more accurate measurement. The output voltage ripple measurement should be taken directly across the output capacitors. As a matter of convenience, the measurement can also be taken across the output terminals if a ceramic 1µF capacitor is mounted on Cf (1206 footprint) to minimize parasitic inductance from the terminals to the output capacitors.

COMPONENT TEMPERATURE RISE

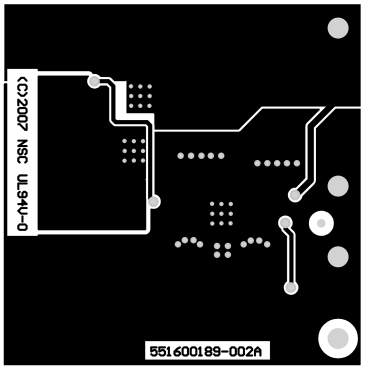
The temperature rise of each device was measured on the case of each device in still air at room temperature.

9.0 Layouts



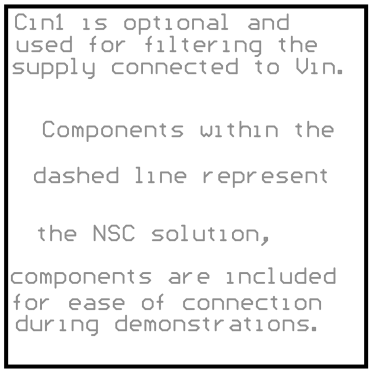
layout7

FIGURE 4. Top Layer



layout8

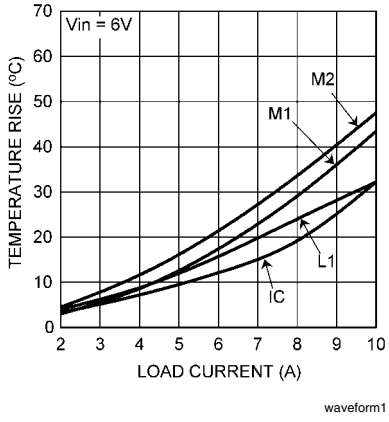
FIGURE 5. Bottom Layer



layout9

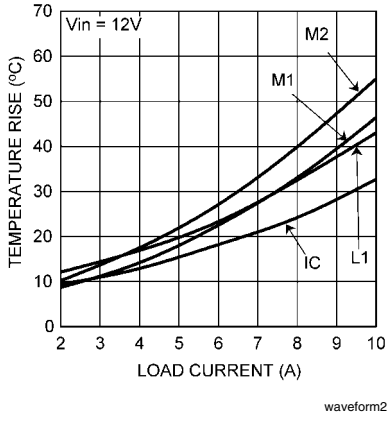
FIGURE 6. Bottom Silkscreen

10.0 Waveforms



waveform1

FIGURE 7. Component Temp Rise vs Load Vin = 6V



waveform2

FIGURE 8. Component Temp Rise vs Load Vin = 12V

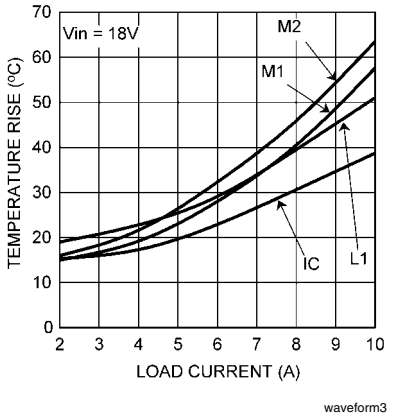


FIGURE 9. Component Temp Rise vs Load Vin = 18V

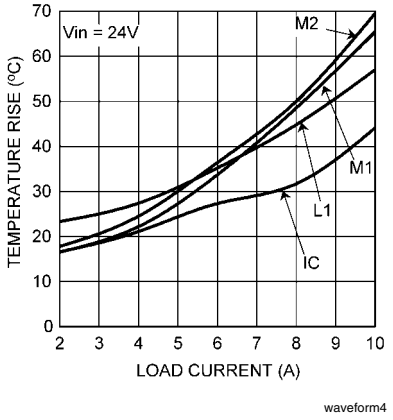


FIGURE 10. Component Temp Rise vs Load Vin = 24V

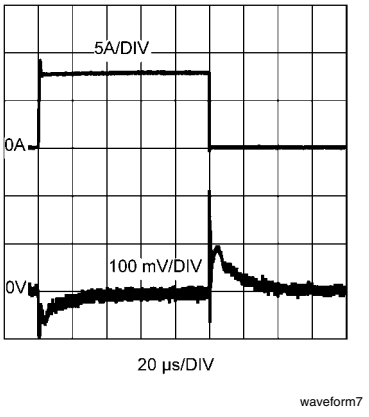


FIGURE 11. Load Transient 0A to 8A

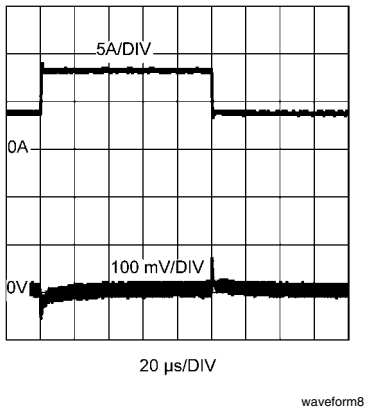


FIGURE 12. Load Transient 3.6A to 8A

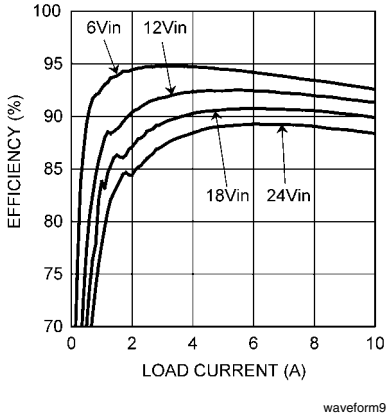


FIGURE 13. Efficiency vs. Load Current

Notes

Notes

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