# LM3152-3.3 Demonstration Board

National Semiconductor
LM3152-3.3
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September 2008

## 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

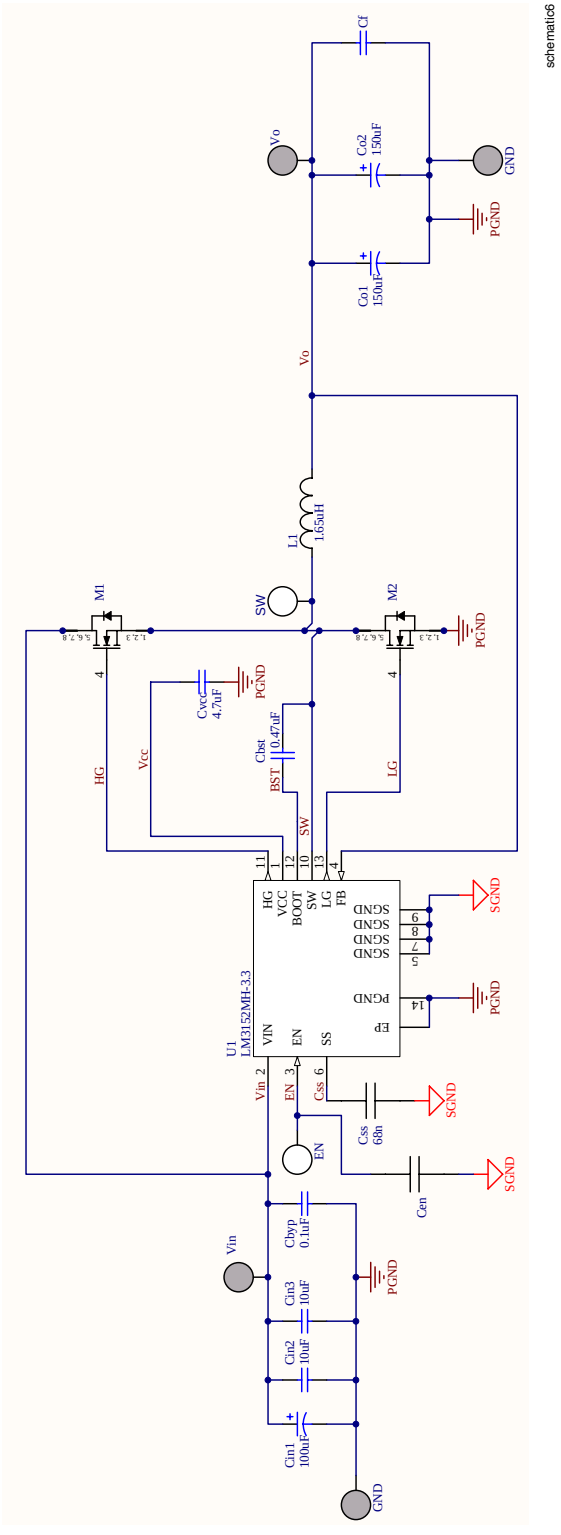



**FIGURE 1. LM3152-3.3 Demo Board Schematic**

| 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.

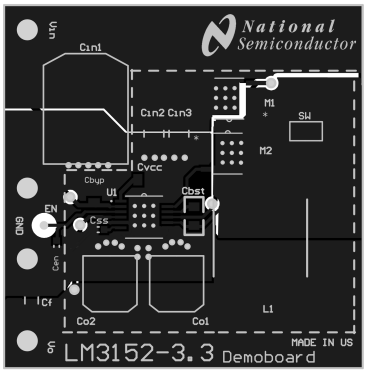
### MEASURING RIPPLE

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

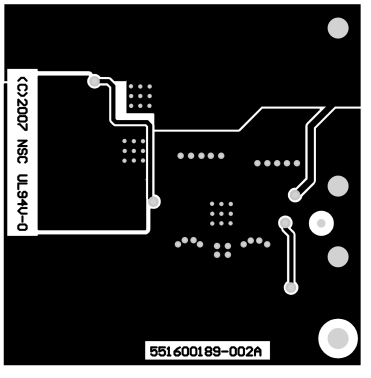
The temperature rise of each device was measured on the case of each device in still air at room temperature.

# 9.0 Layouts




layout7

**FIGURE 4. Top Layer**




layout8

**FIGURE 5. Bottom Layer**

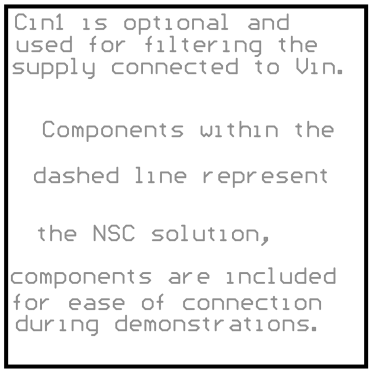



**FIGURE 6. Bottom Silkscreen**

## 10.0 Waveforms

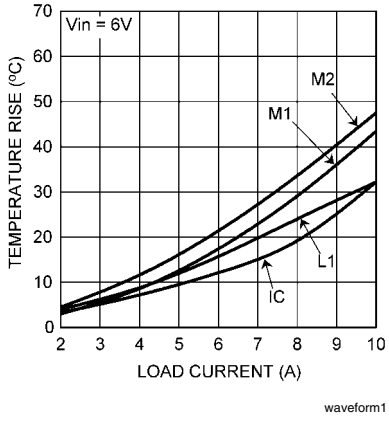



**FIGURE 7. Component Temp Rise vs Load Vin = 6V**

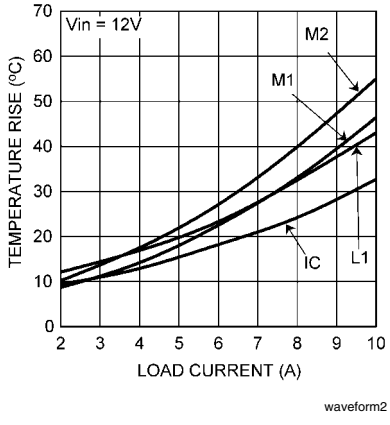



**FIGURE 8. Component Temp Rise vs Load Vin = 12V**

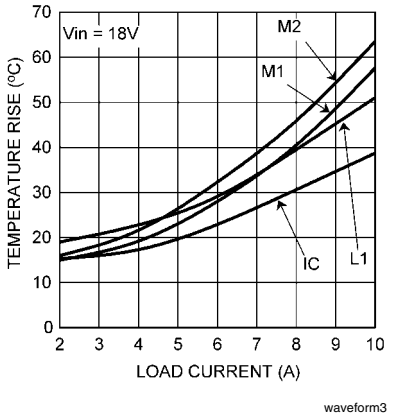



**FIGURE 9. Component Temp Rise vs Load Vin = 18V**

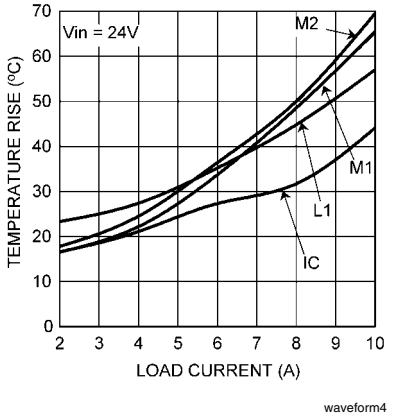



**FIGURE 10. Component Temp Rise vs Load Vin = 24V**

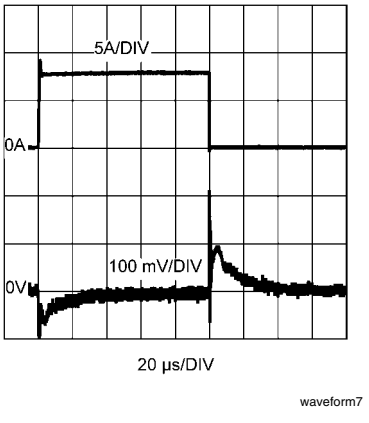



**FIGURE 11. Load Transient 0A to 8A**

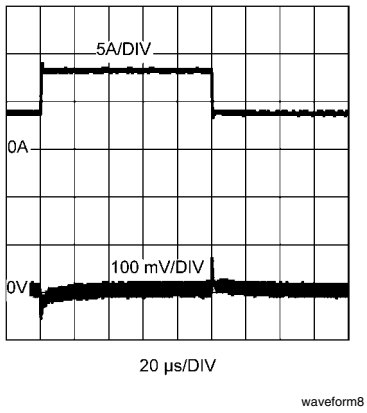



**FIGURE 12. Load Transient 3.6A to 8A**

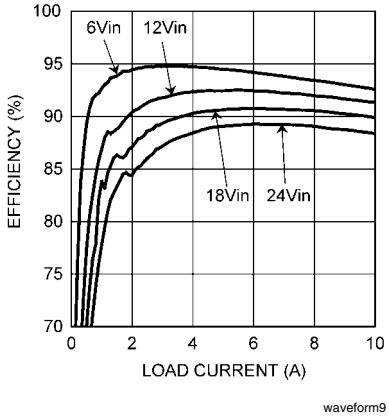



**FIGURE 13. Efficiency vs. Load Current**

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