# LM20145 Demonstration Board

National Semiconductor
LM20145
Dennis Hudgins
November 2007

## 1.0 Design Specifications

| Inputs | Output #1 |
|---|---|
| VinMin=2.95V | Vout1=2.5V |
| VinMax=5.5V | Iout1=5A |

## 2.0 Design Description

The LM20145 demonstration board has been designed to balance overall solution size with the efficiency of the regulator. The demonstration board measures just 1.0" x 1.0" on a two layer PCB, with all components placed on the top layer. The power stage and compensation components of the LM20145 demonstration board have been optimized for an input voltage of 5V, but for testing purposes, the input can be varied across the entire operating range. The output voltage of the evaluation board is nominally 2.5V. The control loop compensation of the LM20145 demonstration board has been designed to provide a stable solution over the entire input and output voltage range with a reasonable transient response. The EN pin is connected to VIN through a 100kOhm resistor which will enable the device when power is applied. Refer to the LM20145 datasheet for complete circuit design information.

## 3.0 Features

- Optimized for 5V to 2.5V conversion
- 5A output current, 89% efficiency
- 1.5% output voltage accuracy
- 500 kHz switching frequency
- Peak current mode control
- Starts up into pre-biased loads
- Soft-Start set by external capacitor
- Precision enable pin with hysteresis
- Integrated OVP, UVLO, power good and thermal shutdown
- Accurate current limit with frequency foldback
- Input voltage range 2.95V to 5.5V

# 4.0 Schematic

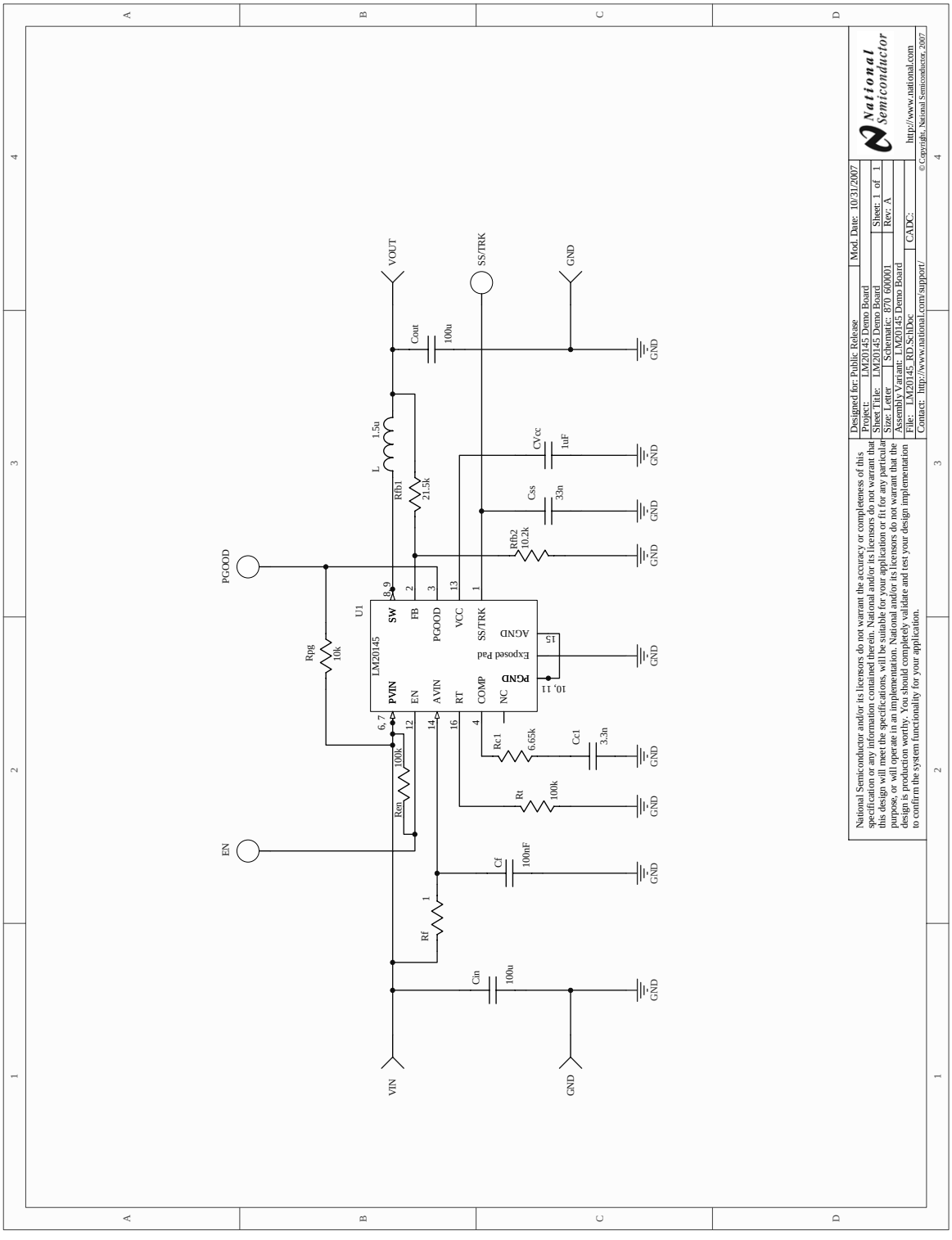



**FIGURE 1. Schematic**

| Designator | CompType | Value | Footprint | Parameters | Vendor | PartNumber | Comment |
|---|---|---|---|---|---|---|---|
| Cc1 | Capacitor | 3.3nF | 0603 | Ceramic, X7R, 25V, 10% | Vishay Vitramon | VJ0603Y332KXXA | |
| Cf | Capacitor | 100nF | 0603 | Ceramic, X7R, 16V, 10% | MuRata | GRM188R71C104KA01D | |
| Cin, Cout | Capacitor | 100uF | 1210 | Ceramic, X5R, 6.3V, 20% | MuRata | GRM32ER60J107ME20 | |
| Css | Capacitor | 33nF | 0603 | Ceramic, X7R, 25V, 10% | Vishay Vitramon | VJ0603Y333KXXA | |
| CVcc | Capacitor | 1uF | 0603 | Ceramic, X5R, 16V, 10% | MuRata | GRM188R60J105KA01 | |
| EN | Test Point | | TESTPOINT | | Keystone | 5004 | Through Hole Test Point, Miniature, Yellow |
| L | Inductor | 1.5uH | | 9.2A, 10.4mOhm | Sumida | CDMC6D28NP-1R5MC | |
| P1, P2, P3, P4 | | | TERM 94MIL | | | | GND, VIN, VOUT |
| PGOOD | Test Point | | TESTPOINT | | Keystone | 5000 | Through Hole Test Point, Miniature, Red |
| Rc1 | Resistor | 6.65kΩ | 0603 | 1%, 0.1W | Vishay | CRCW06036651F-e3 | |
| Ren, Rt | Resistor | 100kΩ | 0603 | 1%, 0.1W | Vishay | CRCW06031003F-e3 | |
| Rf | Resistor | 1Ω | 0603 | 1%, 0.1W | Vishay | CRCW06031R0J-e3 | |
| Rfb1 | Resistor | 21.5kΩ | 0603 | 1%, 0.1W | Vishay | CRCW060321522F-e3 | |
| Rfb2 | Resistor | 10.2kΩ | 0603 | 1%, 0.1W | Vishay | CRCW06031022F-e3 | |
| Rpg | Resistor | 10kΩ | 0603 | 1%, 0.1W | Vishay | CRCW06031002F-e3 | |
| SS/TRK | Test Point | | TESTPOINT | | Keystone | 5002 | Through Hole Test Point, Miniature, White |
| U1 | Switcher | | MXA16A | | National Semiconductor | LM20145 | |

bom5

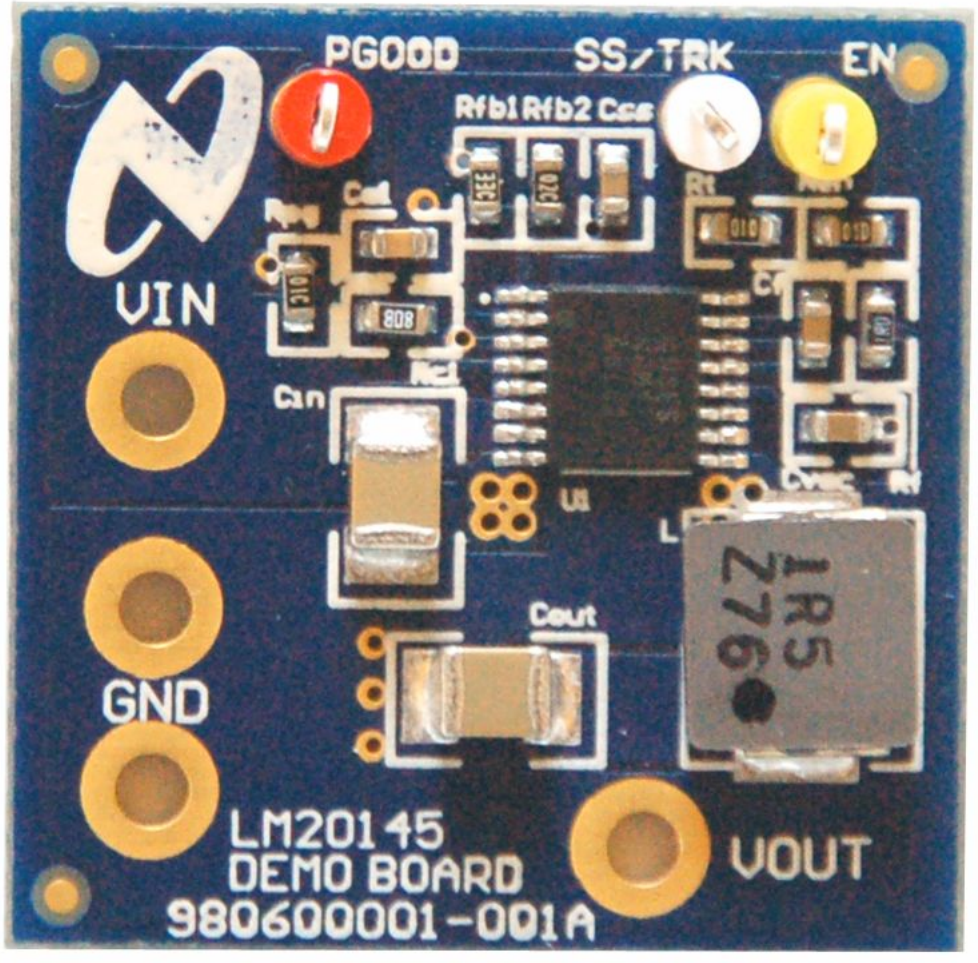
**FIGURE 2. Bill of Materials**

## 6.0 Other Operating Values

**Operating Values**

| Description | Parameter | Value | Unit |
|---|---|---|---|
| Modulation Frequency | Frequency | 500 | KHz |
| Total output power | Pout | 12.5 | W |
| Steady State Efficiency | Efficiency | 89 | % |
| Control scheme | Control scheme | CMD | |
| Peak-to-peak ripple voltage | Vout p-p | 11 | mV |
| Static load regulation | Static load | 5 | mV |

## 7.0 Board Photos




boardphoto

**FIGURE 3. LM20145 (actual size 1" x 1")**

## 8.0 Quick Start

This section lists the terminals on the board by their silkscreen label, and gives a brief description of how to use them.

**PCB Silkscreen - Description**

**VIN** - This terminal connects to the input voltage to the device. Since this terminal has no populated connection, a 16 gauge or larger wire is recommended to connect the PCB to an external power supply. The device will operate over the input voltage range of 2.95V to 5.5V. The absolute maximum voltage rating for this pin is 6V.

**GND** - This terminal is the ground connection to the device. There are two different GND connections on the PCB. One should be used for the input supply the other for the load. Since this terminal has no populated connection a 16 gauge or larger wire is recommended for the ground connections.

**VOUT** - This terminal connects to the output voltage of the power supply. Since this terminal has no populated connection a 16 gauge or larger wire is recommended to connect the output to the load.

**EN** - This terminal connects to the enable pin of the device. There is a 100 kΩ pull-up resistor from enable to VIN so the device will self enable when power is applied. If driven externally, a voltage typically greater than 1.18V will enable the device. The operating voltage for this pin should not exceed 5.5V. The absolute maximum voltage rating on this pin is 6V.

**SS/TRK** - This terminal provides access to the SS/TRK pin of the device. Connections to this terminal are not needed for most applications. The feedback pin of the device will track the voltage on the SS/TRK pin if it is driven with an external voltage source that is below the 0.8V reference. The voltage on this pin should not exceed 5.5V during normal operation. The absolute maximum voltage rating on this pin is 6V.

**PGOOD** - This terminal connects to the power good output of the device. There is a 10 kΩ pull-up resistor from this pin to the input voltage. The voltage on this pin should not exceed 5.5V during normal operation and has an absolute maximum voltage rating of 6V.

## 9.0 Layouts

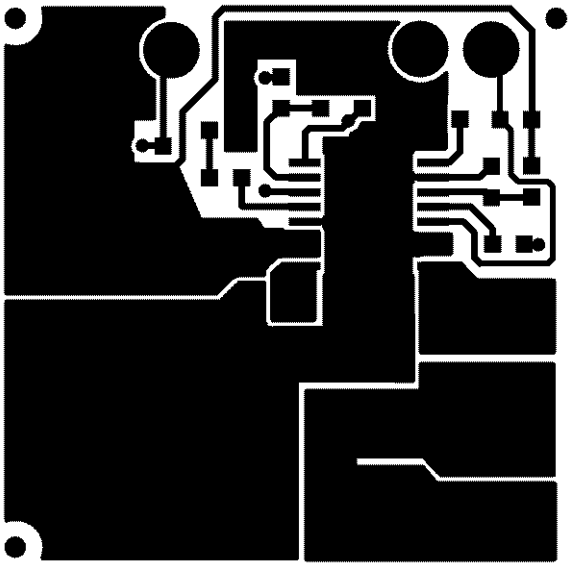
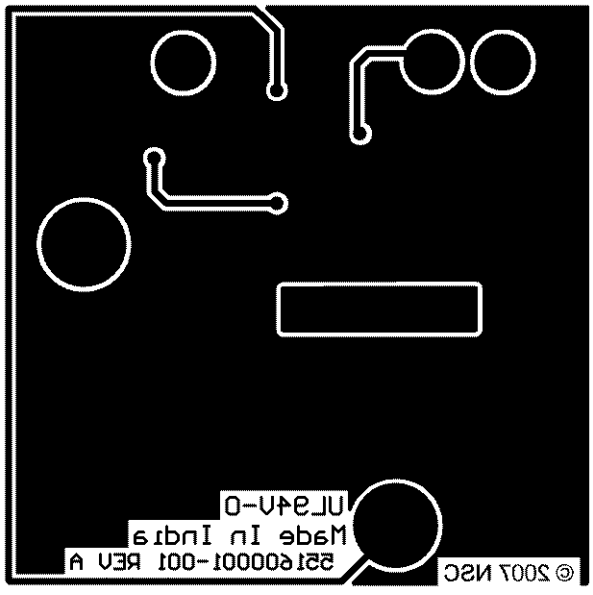


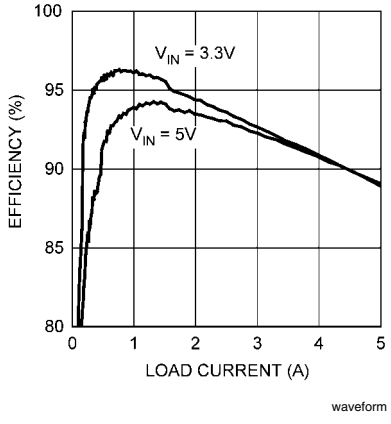

**FIGURE 4. Top Layer**




layout1

**FIGURE 5. Bottom Layer**

## 10.0 Waveforms




waveform

**FIGURE 6. Efficiency vs Load**

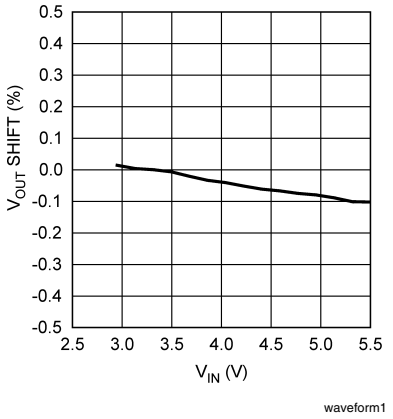



**FIGURE 7. Line Regulation @ Iload = 5A**

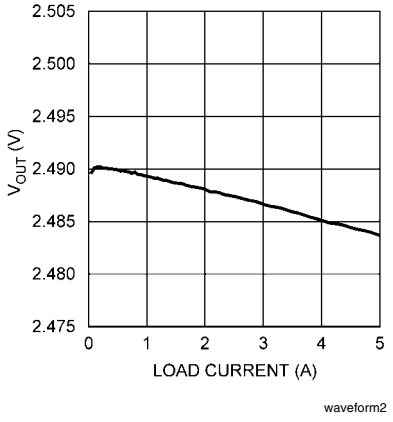



**FIGURE 8. Load Regulation @Vin = 5V**

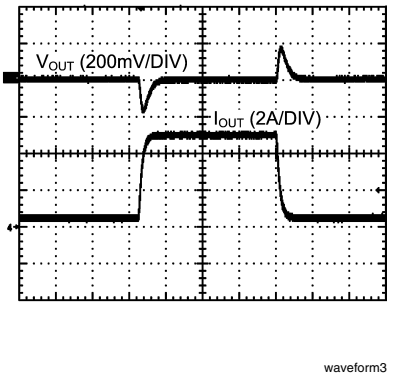



**FIGURE 9. 0.5A to 5A Load Transient Response (200 us/DIV)**

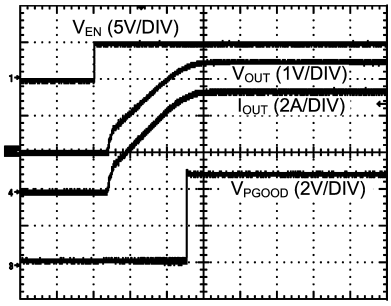
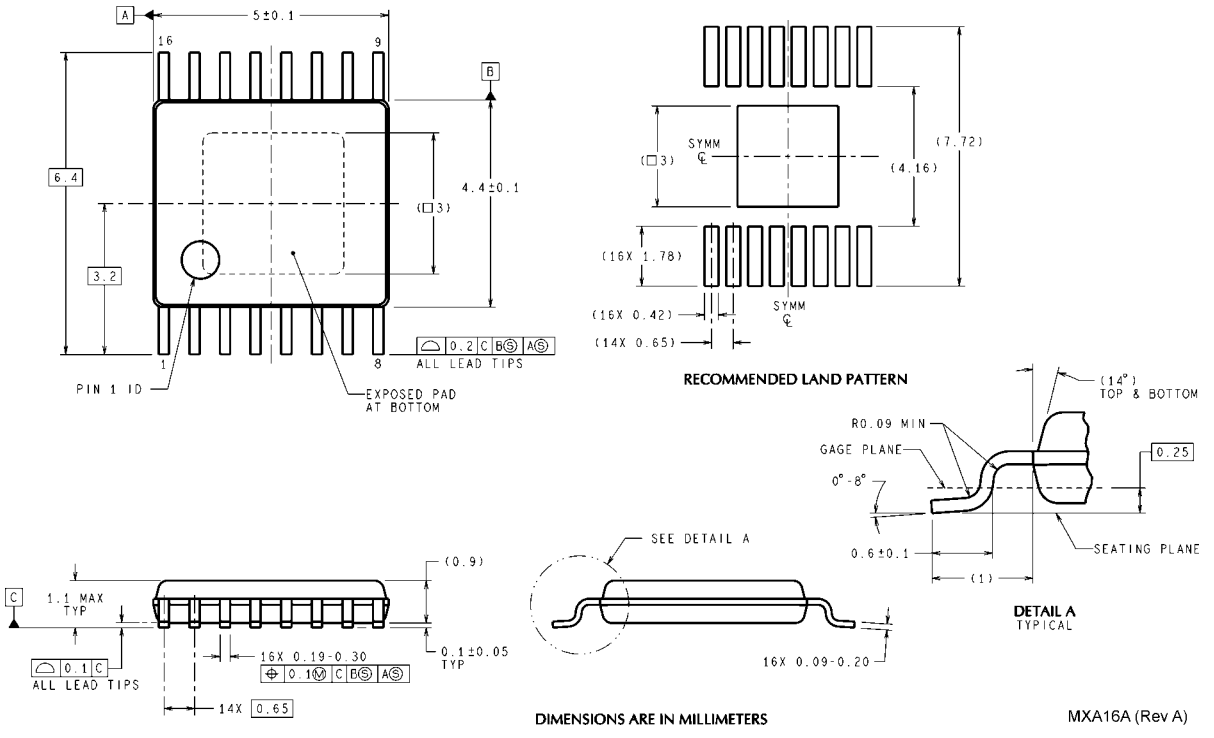



**FIGURE 10. Startup Waveform (2ms/DIV)**

## 11.0 Physical Dimensions inches (millimeters) unless otherwise noted




DIMENSIONS ARE IN MILLIMETERS

MXA16A (Rev A)

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