

# 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

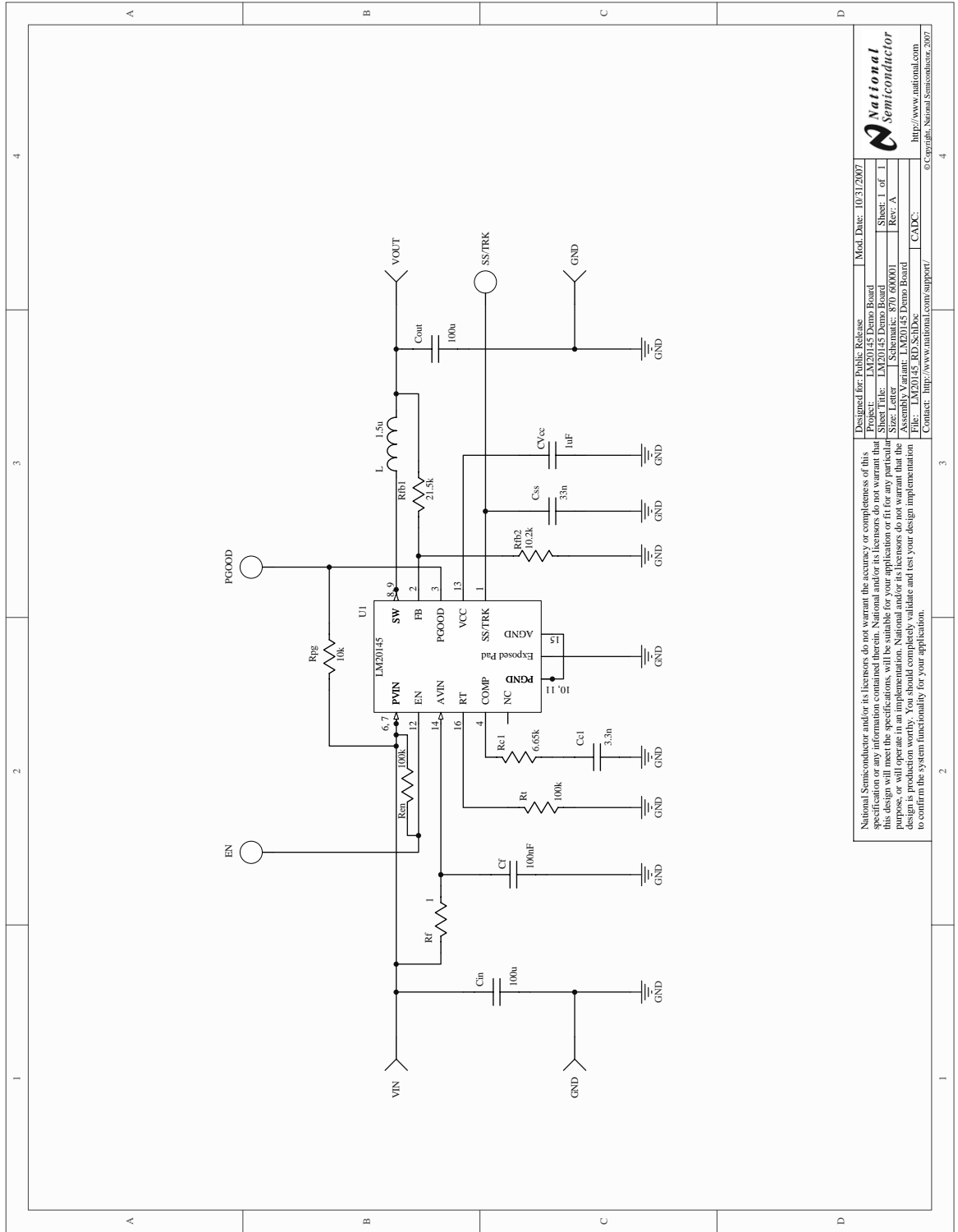
## 2.0 Design Description

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



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		Demo Board		Sheet 1 of 1	
		LM20145 Demo Board		Rev: A	
		Size: Letter		Schematic: 870 000001	
		Assembly Variant: LM20145 Demo Board		CADDC:	
		File: LM20145_RD_Sch.Dwg		Contact: <a href="http://www.national.com/support/">http://www.national.com/support/</a>	
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FIGURE 1. Schematic

# 5.0 Bill of Materials

Designator	CompType	Value	Footprint	Parameters	Vendor	PartNumber	Comment
Cc1	Capacitor	3.3nF	0603	Ceramic, X7R, 25V, 10%	Vishay Vitramon	VJ0603Y33KXXA	
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	VJ0603Y33KXXA	
Cvcc	Capacitor	1uF	0603	Ceramic, X5R, 16V, 10%	MuRata	GRM188R60J105KA01	Through Hole Test Point, Miniature, Yellow
EN	Test Point		TESTPOINT		Keystone	5004	
L	Inductor	1.5uH		9.2A, 10.4mOhm	Sumida	CDMCD28NP-1R5MC	GND, VIN, VOUT Through Hole Test Point, Miniature, Red
P1, P2, P3, P4	Test Point		TERM 94MIL		Keystone	5000	
PGOOD	Resistor	6.65kQ	TESTPOINT	1%, 0.1W	Vishay	CRCW06036651F-e3	
Rc1	Resistor	100kQ	0603	1%, 0.1W	Vishay	CRCW06031003F-e3	
Ren, Rf	Resistor	1Q	0603	1%, 0.1W	Vishay	CRCW06031R0J-e3	
Rb1	Resistor	21.5kQ	0603	1%, 0.1W	Vishay	CRCW060321522F-e3	
Rb2	Resistor	10.2kQ	0603	1%, 0.1W	Vishay	CRCW06031022F-e3	
Rg	Resistor	10kQ	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	

boms

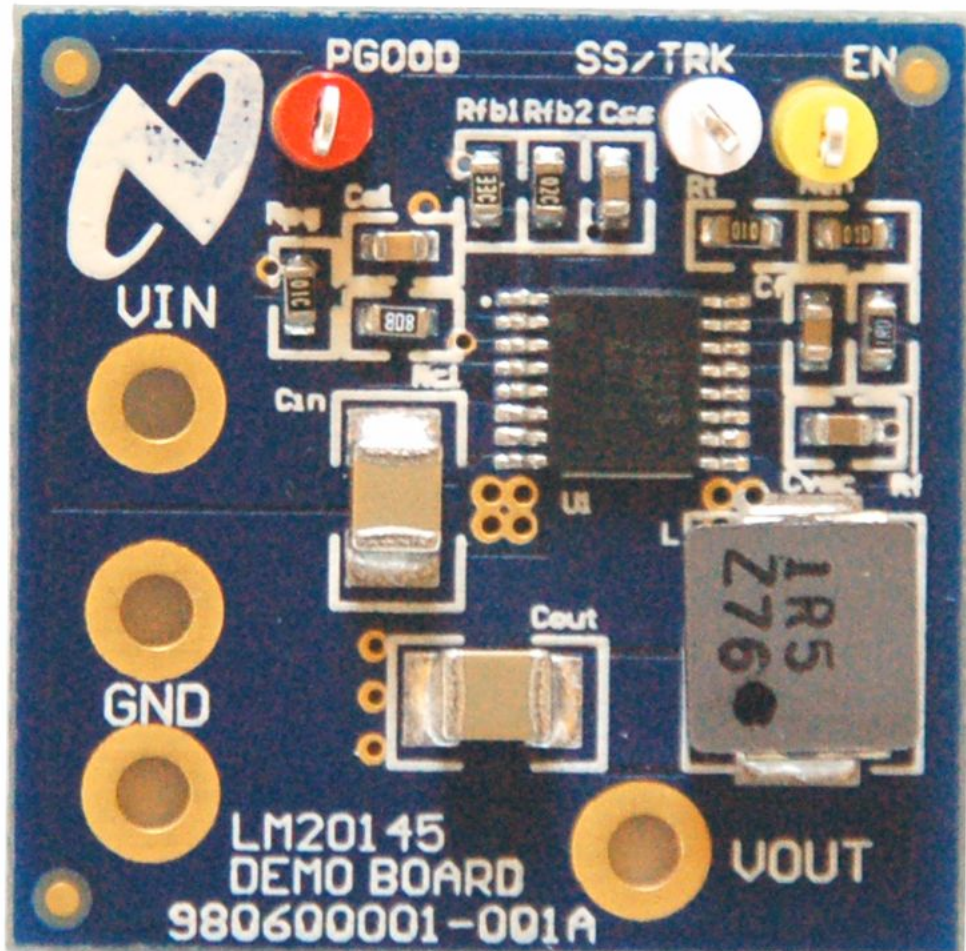
FIGURE 2. Bill of Materials

## 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 k $\Omega$  pull-up resistor from enable to VIN so the device will self enable when power is applied. If driven externally, a

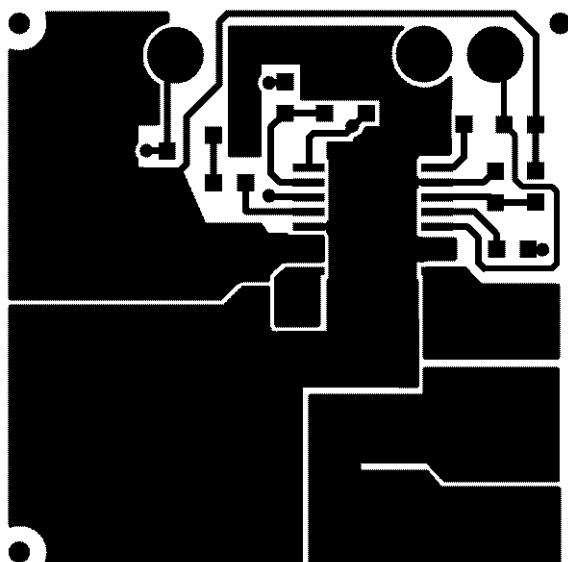
voltage typically greater than 1.18V will enable the device. The operating voltage for this pin should not exceed 5.5V. The absolute maximum voltage rating on this pin is 6V.

**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.

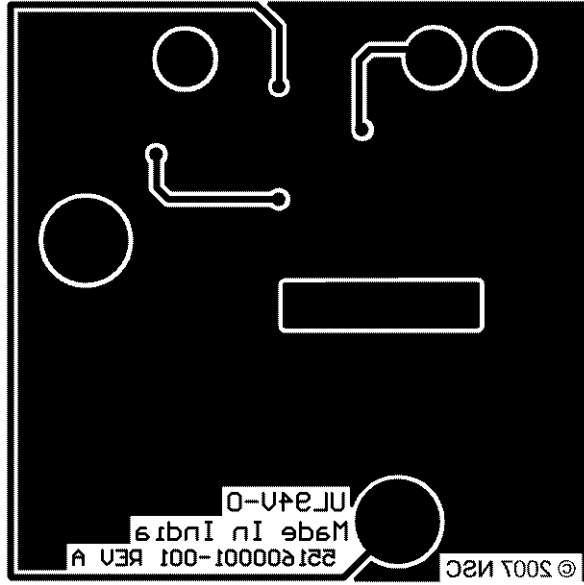
**PGOOD** - This terminal connects to the power good output of the device. There is a 10 k $\Omega$  pull-up resistor from this pin to the input voltage. The voltage on this pin should not exceed 5.5V during normal operation and has an absolute maximum voltage rating of 6V.

## 9.0 Layouts



layout

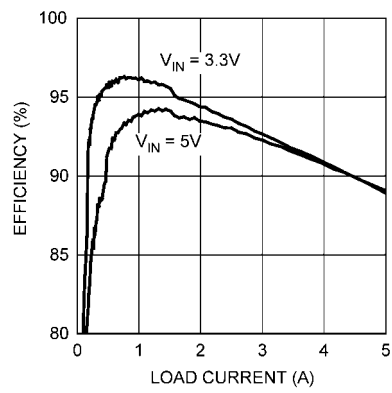
FIGURE 4. Top Layer



layout1

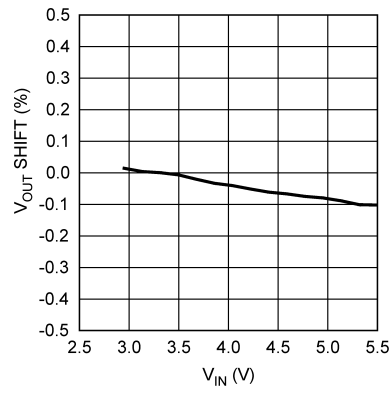
FIGURE 5. Bottom Layer

## 10.0 Waveforms



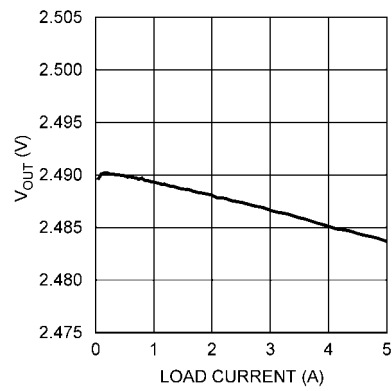
waveform

FIGURE 6. Efficiency vs Load



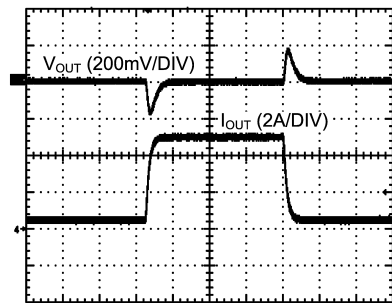
waveform1

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



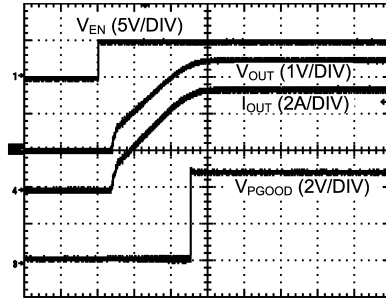
waveform2

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



waveform3

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

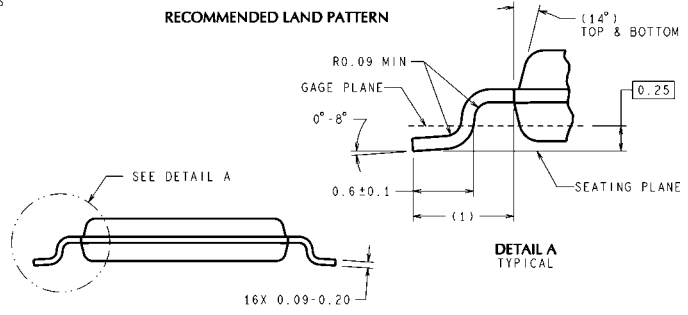
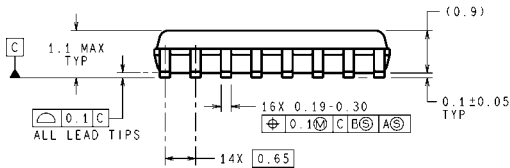
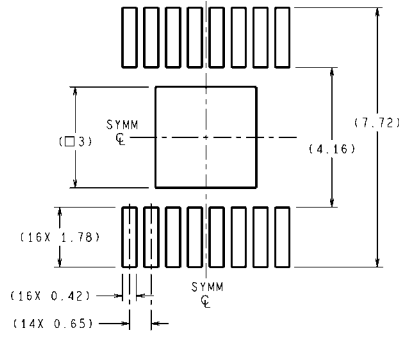
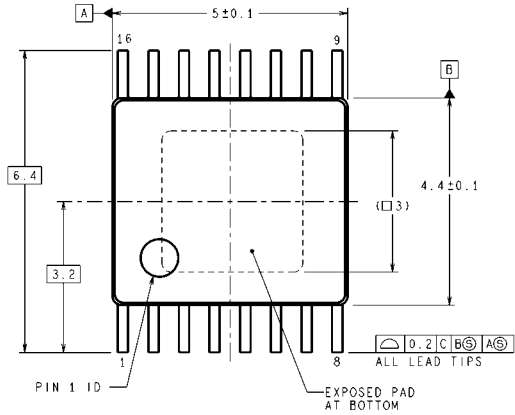


waveform4

**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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