National Semiconductor

LM3100
SIMPLE SWITCHER® Synchronous 1MHz 1.5A Step-Down Voltage Regulator

General Description

The LM3100 Synchronously Rectified Buck Converter features all functions needed to implement a highly efficient, cost effective buck regulator capable of supplying 1.5A to loads with voltages as low as 0.8V. Dual 40V N-Channel synchronous MOSFET switches allow for low external component thus reducing complexity and minimizing board space. The LM3100 is designed to work exceptionally well with ceramic and other very low ESR output capacitors. The Constant ON-Time (COT) regulation scheme requires no loop compensation, results in fast load transient response, and simplifies circuit implementation. Through the use of a unique design the regulator does not rely on output capacitor ESR for stability, as do most other COT regulators. The operating frequency remains nearly constant with line and load variations due to the inverse relationship between the input voltage and the on-time. The oprating frequency can be externally programmed up to 1MHz. Protection features include V_{CC} under-voltage lockout, thermal shutdown and gate drive undervoltage lockout. The part is available in a thermally enhanced eTSSOP-20 package

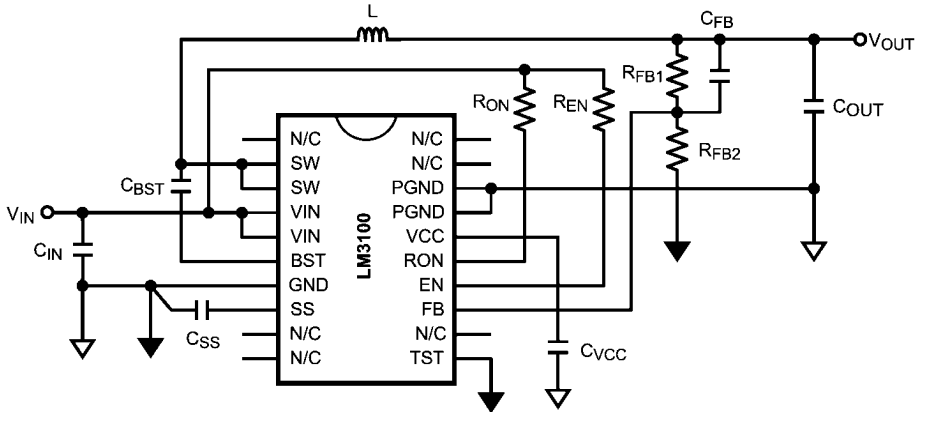
Features

- Input voltage range 4.5V - 36V
- 1.5A output current
- 0.8V, ±1.5% reference
- Integrated 40V, dual N-Channel buck synchronous switches
- Low component count and small solution size
- No loop compensation required
- Ultra-fast transient response
- Stable with ceramic and other low ESR capacitors
- Programmable switching frequency up to 1MHz
- Max. duty cycle limited during start-up
- Valley current limit
- Precision Internal Reference for adjustable output voltage down to 0.8V
- Thermal shutdown
- Thermally enhanced eTSSOP-20 package

Typical Applications

- 5VDC, 12VDC, 24VDC, 12VAC, and 24VAC systems
- Embedded Systems
- Industrial Controls
- Automotive Telematics and Body Electronics
- Point of Load Regulators
- Storage Systems
- Broadband Infrastructure
- Direct Conversion from 2/3/4 Cell Lithium Batteries Systems

Typical Application



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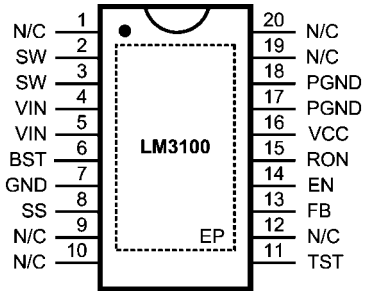
Connection Diagram



20-lead Plastic
eTSSOP (MXA20A)

Ordering Information

Order Number	Package Type	NSC Package Drawing	Supplied As
LM3100MH	Exposed Pad TSSOP-20	MXA0020	73 units per Anti-Static Tube
LM3100MHX			2500 Units on Tape and Reel

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

VIN, RON to GND	-0.3V to 40V
SW to GND	-0.3V to 40V
SW to GND (Transient)	-2V (< 100ns)
VIN to SW	-0.3V to 40V
BST to SW	-0.3V to 7V
All Other Inputs to GND	-0.3V to 7V
ESD Rating (Note 2)	
Human Body Model	±2kV
Storage Temperature Range	-65°C to +150°C
Junction Temperature (T_J)	150°C

Operating Ratings (Note 1)

Supply Voltage Range (VIN)	4.5V to 36V
Junction Temperature Range (T_J)	–40°C to + 125°C
Thermal Resistance (θ_{JC}) (Note 3)	6.5°C/W

Electrical Characteristics

Specifications with standard type are for T_J = 25°C only; limits in boldface type apply over the full Operating Junction Temperature (T_J) range. Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only. Unless otherwise stated the following conditions apply: V_{IN} = 18V, V_{OUT} = 3.3V.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Start-Up Regulator, V_{CC}						
V_{CC}	V_{CC} output voltage	C_{CC} = 680nF, no load	**5.0**	6.0	**7.2**	V
V_{IN} - V_{CC}	V_{IN} - V_{CC} dropout voltage	I_{CC} = 2mA		50	**140**	mV
		I_{CC} = 20mA		350	**570**	
I_{VCCL}	V_{CC} current limit (Note 4)	V_{CC} = 0V	**40**	65		mA
$V_{CC-UVLO}$	V_{CC} under-voltage lockout threshold (UVLO)	V_{IN} increasing	**3.6**	3.75	**3.85**	V
$V_{CC-UVLO-HYS}$	V_{CC} UVLO hysteresis	V_{IN} decreasing		130		mV
$t_{VCC-UVLO-D}$	V_{CC} UVLO filter delay			3		µs
I_{IN}	I_{IN} operating current	No switching, V_{FB} = 1V		0.7	**1**	mA
I_{IN-SD}	I_{IN} operating current, Device shutdown	V_{EN} = 0V		17	**30**	µA
Switching Characteristics						
$R_{DS-UP-ON}$	Main MOSFET Rds(on)			0.18	**0.35**	Ω
$R_{DS-DN-ON}$	Syn. MOSFET Rds(on)			0.11	**0.2**	Ω
V_{G-UVLO}	Gate drive voltage UVLO	V_{BST} - V_{SW} increasing		3.3	**4**	V
Soft-start						
I_{SS}	SS pin source current	V_{SS} = 0.5V	**6**	8	**9.8**	µA
Current Limit						
I_{CL}	Syn. MOSFET current limit threshold			1.9		A
ON/OFF Timer						
t_{ON}	ON timer pulse width	V_{IN} = 10V, R_{ON} = 100 kΩ		1.38		µs
		V_{IN} = 30V, R_{ON} = 100 kΩ		0.47		
t_{ON-MIN}	ON timer minimum pulse width			200		ns
t_{OFF}	OFF timer pulse width			260		ns
Enable Input						
V_{EN}	EN Pin input threshold	V_{EN} rising	**1.236**	1.26	**1.285**	V
V_{EN-HYS}	Enable threshold hysteresis	V_{EN} falling		90		mV
Regulation and Over-Voltage Comparator						
V_{FB}	In-regulation feedback voltage	V_{SS} ≥ 0.8V T_J = –40°C to + 125°C	**0.784**	0.8	**0.816**	V
		V_{SS} ≥ 0.8V T_J = 0°C to + 125°C	**0.788**		**0.812**	
V_{FB-OV}	Feedback over-voltage threshold		**0.894**	0.920	**0.940**	V
I_{FB}				5	**100**	nA

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Thermal Shutdown						
T_{SD}	Thermal shutdown temperature	T_J rising		165		°C
T_{SD-HYS}	Thermal shutdown temperature hysteresis	T_J falling		20		°C

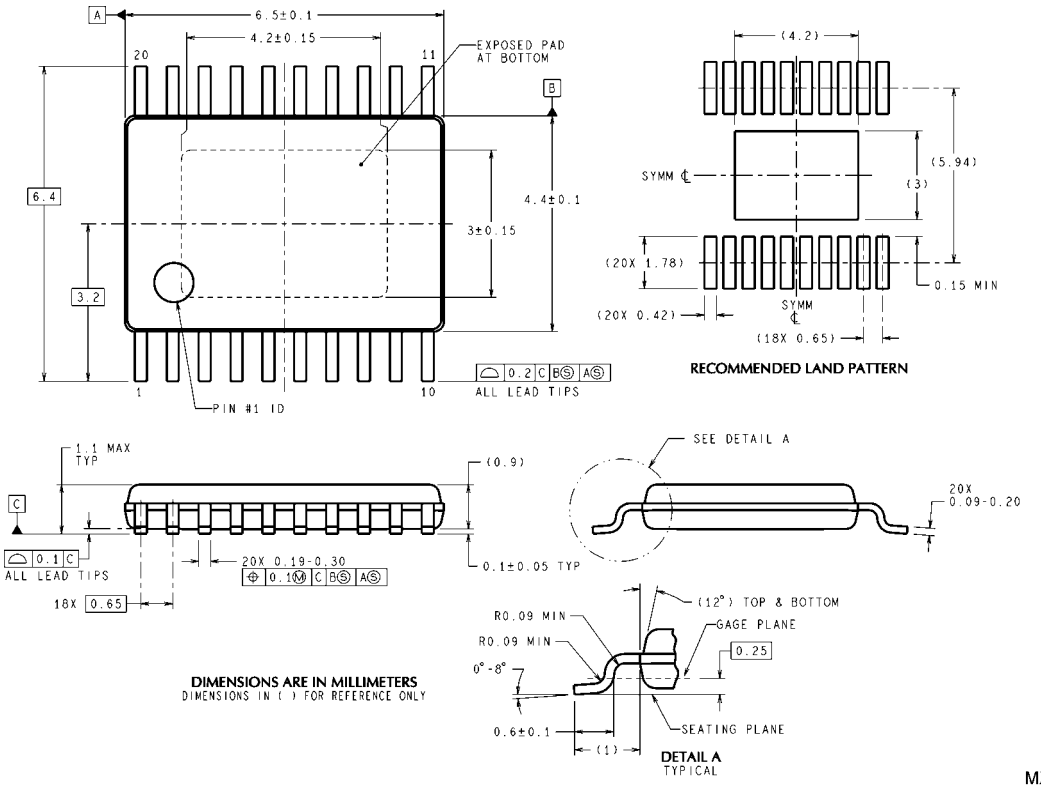
Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which operation of the device is intended to be functional. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

Note 3: θ_{JC} measurements are performed in general accordance with Mil-Std 883B, Method 1012.1 and utilizes the copper heat sink technique. Copper Heat Sink @ 60°C.

Note 4: V_{CC} provides self bias for the internal gate drive and control circuits. Device thermal limitations limit external loading.

Physical Dimensions inches (millimeters) unless otherwise noted



MXA20A (Rev C)

20-Lead Plastic eTSSOP Package
NS Package Number MXA20A