

SIMPLE SWITCHER® 42V, 3A Step-Down Switching Regulator

General Description

The LM25576 is an easy to use SIMPLE SWITCHER® buck regulator which allows design engineers to design and optimize a robust power supply using a minimum set of components. Operating with an input voltage range of 6 - 42V, the LM25576 delivers 3A of continuous output current with an integrated 170mΩ N-Channel MOSFET. The regulator utilizes an Emulated Current Mode architecture which provides inherent line regulation, tight load transient response, and ease of loop compensation without the usual limitation of low-duty cycles associated with current mode regulators. The operating frequency is adjustable from 50kHz to 1MHz to allow optimization of size and efficiency. To reduce EMI, a frequency synchronization pin allows multiple IC's from the LM(2)557x family to self-synchronize or to synchronize to an external clock. The LM25576 guarantees robustness with cycle-by-cycle current limit, short-circuit protection, thermal shut-down, and remote shut-down. The device is available in a power enhanced TSSOP-20 package featuring an exposed die attach pad for thermal dissipation. The LM25576 is supported by the full suite of WEBENCH® On-Line design tools.

Features

- LM25576Q is an Automotive Grade product that is AEC-Q100 grade 1 qualified (-40°C to + 125°C operating junction temperature)
- Integrated 42V, 170mΩ N-channel MOSFET
- Ultra-wide input voltage range from 6V to 42V
- Adjustable output voltage as low as 1.225V
- 1.5% feedback reference accuracy
- Operating frequency adjustable between 50kHz and 1MHz with single resistor
- Master or slave frequency synchronization
- Adjustable soft-start
- Emulated current mode control architecture
- Wide bandwidth error amplifier
- Built-in protection
- Automotive Grade product datasheet that is AEC-Q100 grade 0 qualified is available upon request. (-40°C to + 150°C operating junction temperature)

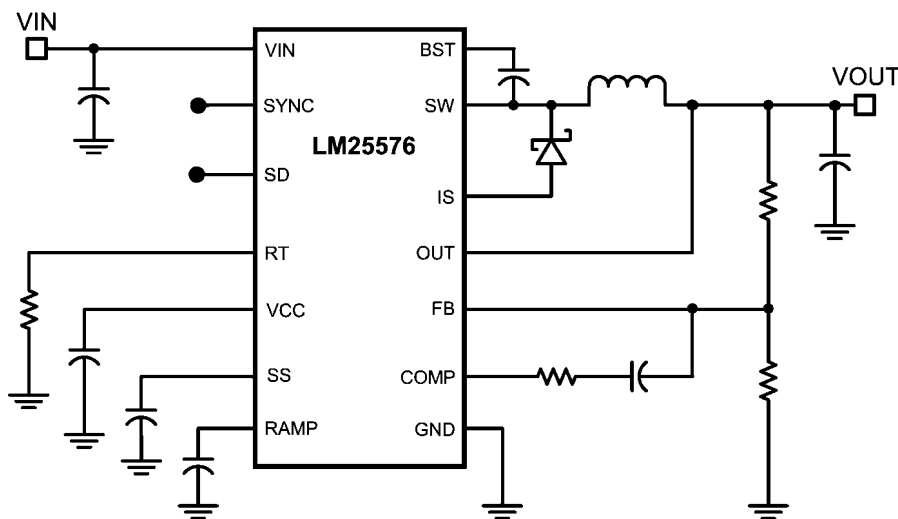
Package

- TSSOP-20EP (Exposed Pad)

Applications

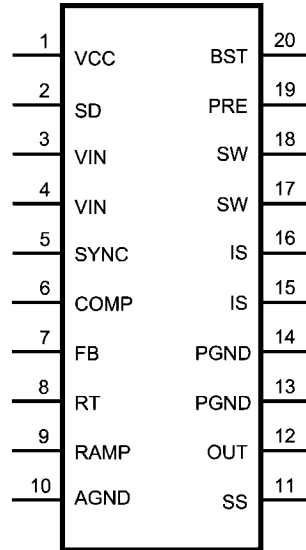
- Automotive
- Industrial

Simplified Application Schematic



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Connection Diagram



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Top View
20-Lead TSSOP

Ordering Information

Order Number	Package Type	NSC Package Drawing	Supplied As	Features
LM25576MH	Exposed Pad TSSOP-20	MXA20A	73 Units in Rail	
LM25576MHX	Exposed Pad TSSOP-20	MXA20A	2500 Units on Tape and Reel	
LM25576QMH	Exposed Pad TSSOP-20	MXA20A	73 Units in Rail	AEC-Q100 Grade 1 qualified. Automotive Grade Production Flow *
LM25576QMHX	Exposed Pad TSSOP-20	MXA20A	2500 Units on Tape and Reel	

* Automotive Grade (Q) product incorporates enhanced manufacturing and support processes for the automotive market, including defect detection methodologies. Reliability qualification is compliant with the requirements and temperature grades defined in the AEC-Q100 standard. Automotive grade products are identified with the letter Q. For more information go to <http://www.national.com/automotive>.

Absolute Maximum Ratings (Note 1)

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

V_{IN} to GND	45V
BST to GND	60V
PRE to GND	45V
SW to GND (Steady State)	-1.5V
BST to V_{CC}	45V
SD, V_{CC} to GND	14V

BST to SW	14V
OUT to GND	Limited to V_{in}
SYNC, SS, FB, RAMP to GND	7V
ESD Rating (Note 2)	
Human Body Model	2kV
Storage Temperature Range	-65°C to +150°C

Operating Ratings (Note 1)

V_{IN}	6V to 42V
Operation Junction Temperature	-40°C to +125°C

Electrical Characteristics Specifications with standard typeface are for $T_J = 25^\circ\text{C}$, and those with **boldface** type apply over full **Operating Junction Temperature range**. $V_{IN} = 24\text{V}$, $R_T = 32.4\text{k}\Omega$ unless otherwise stated. (Note 3)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
STARTUP REGULATOR						
VccReg	Vcc Regulator Output		6.85	7.15	7.45	V
	Vcc LDO Mode turn-off			9		V
	Vcc Current Limit	$V_{cc} = 0\text{V}$		25		mA
VCC SUPPLY						
	Vcc UVLO Threshold	(Vcc increasing)	5.03	5.35	5.67	V
	Vcc Undervoltage Hysteresis			0.25		V
	Bias Current (Iin)	FB = 1.3V		3.4	4.5	mA
	Shutdown Current (Iin)	SD = 0V		48	70	μA
SHUTDOWN THRESHOLDS						
	Shutdown Threshold	(SD Increasing)	0.47	0.7	0.9	V
	Shutdown Hysteresis			0.1		V
	Standby Threshold	(Standby Increasing)	1.17	1.225	1.28	V
	Standby Hysteresis			0.1		V
	SD Pull-up Current Source			5		μA
SWITCH CHARACTERISTICS						
	Buck Switch Rds(on)			170	340	m Ω
	BOOST UVLO			3.8		V
	BOOST UVLO Hysteresis			0.56		V
	Pre-charge Switch Rds(on)			70		Ω
	Pre-charge Switch on-time			265		ns
CURRENT LIMIT						
	Cycle by Cycle Current Limit	RAMP = 0V	3.6	4.2	5.1	A
	Cycle by Cycle Current Limit Delay	RAMP = 2.5V		100		ns
SOFT-START						
	SS Current Source		7	10	14	μA
OSCILLATOR						
	Frequency1		180	200	220	kHz
	Frequency2	$R_T = 11\text{k}\Omega$	425	485	545	kHz
	SYNC Source Impedance			11		k Ω
	SYNC Sink Impedance			110		Ω
	SYNC Threshold (falling)			1.3		V
	SYNC Frequency	$R_T = 11\text{k}\Omega$	550			kHz
	SYNC Pulse Width Minimum		15			ns

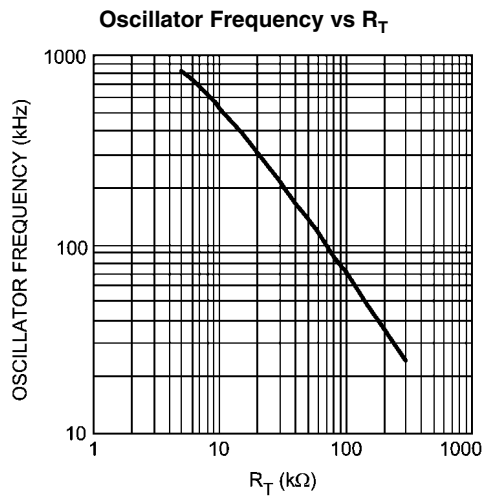
Symbol	Parameter	Conditions	Min	Typ	Max	Units
RAMP GENERATOR						
	Ramp Current 1	Vin = 36V, Vout=10V	136	160	184	μA
	Ramp Current 2	Vin = 10V, Vout=10V	18	25	32	μA
PWM COMPARATOR						
	Forced Off-time		416	500	575	ns
	Min On-time			80		ns
	COMP to PWM Comparator Offset			0.7		V
ERROR AMPLIFIER						
	Feedback Voltage	Vfb = COMP	1.207	1.225	1.243	V
	FB Bias Current			17		nA
	DC Gain			70		dB
	COMP Sink / Source Current		3			mA
	Unity Gain Bandwidth			3		MHz
DIODE SENSE RESISTANCE						
D _{SENSE}				42		mΩ
THERMAL SHUTDOWN						
Tsd	Thermal Shutdown Threshold			165		°C
	Thermal Shutdown Hysteresis			25		°C
THERMAL RESISTANCE						
θ _{JC}	Junction to Case			6		°C/W
θ _{JA}	Junction to Ambient			40		°C/W

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.

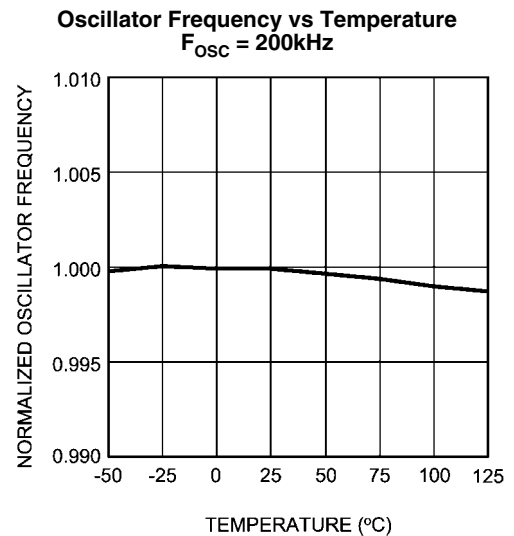
Note 2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

Note 3: Min and Max limits are 100% production tested at 25°C. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods. Limits are used to calculate National's Average Outgoing Quality Level (AOQL).

Typical Performance Characteristics

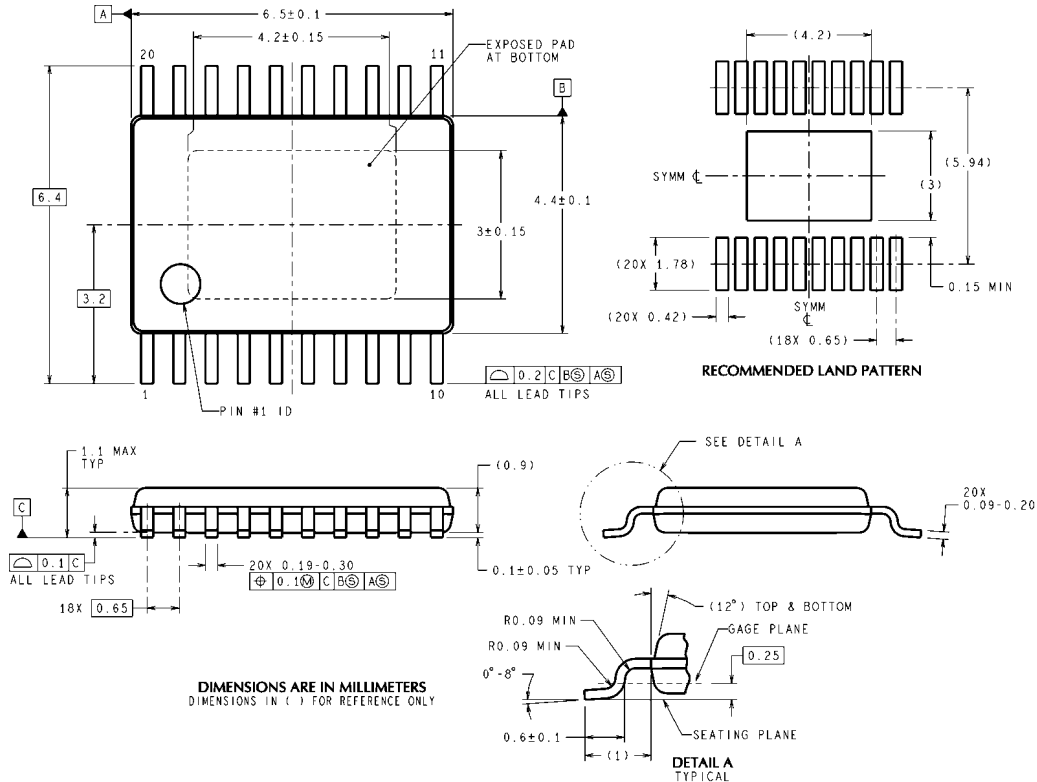


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Physical Dimensions inches (millimeters) unless otherwise noted



20-Lead TSSOP Package
NS Package Number MXA20A

MXA20A (Rev C)