

# LM22680

## 2A SIMPLE SWITCHER®, Step-Down Voltage Regulator with Features

### General Description

The LM22680 series of regulators are monolithic integrated circuits which provide all of the active functions for a step-down (buck) switching regulator capable of driving up to 2A loads with excellent line and load regulation characteristics. High efficiency (>90%) is obtained through the use of a low ON-resistance N-channel MOSFET. The series consists of an adjustable version.

The SIMPLE SWITCHER® concept provides for an easy to use complete design using a minimum number of external components and National's WEBENCH® design tool. National's WEBENCH® tool includes features such as external component calculation, electrical simulation, thermal simulation, and Build-It boards for easy design-in. The switching clock frequency is provided by an internal fixed frequency oscillator which operates at 500 kHz. The switching frequency can also be adjusted with an external resistor or synchronized to an external clock up to 1MHz. It is also possible to self-synchronize multiple regulators to share the same switching frequency. The LM22680 series also has built in thermal shut-down, current limiting and an enable control input that can power down the regulator to a low 25  $\mu$ A quiescent current standby condition. An adjustable soft-start feature is provided by selecting an appropriate external soft-start capacitor.

### Features

- Wide input voltage range: 4.5V to 42V
- Internally compensated voltage mode control
- Stable with low ESR ceramic capacitors
- 200 m $\Omega$  N-channel MOSFET
- Output voltage: -ADJ (outputs as low as 1.285V)
- $\pm$ 1.5% feedback reference accuracy
- Switching frequency of 500 kHz, adjustable between 200 kHz and 1 MHz
- -40°C to 125°C operating junction temperature range
- Precision enable pin
- Integrated boot diode
- Adjustable soft-start
- Fully WEBENCH® enabled
- Step-down and inverting buck-boost applications

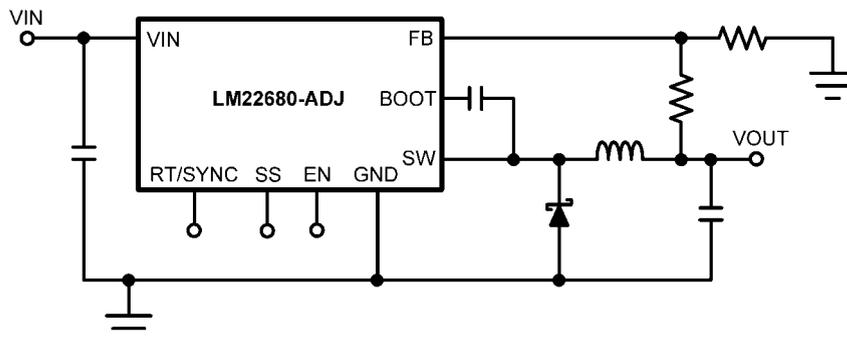
### Package

- PSOP-8 (Exposed Pad)

### Applications

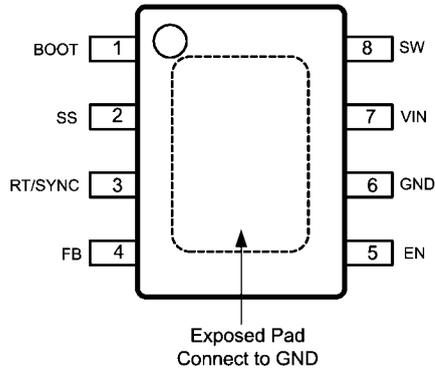
- Industrial Control
- Telecom and Datacom Systems
- Embedded Systems
- Automotive Telematics and Body Electronics
- Conversions from Standard 24V, 12V and 5V Input Rails

### Simplified Application Schematic



30080751

## Connection Diagram



8-Lead Plastic PSOP-8 Package  
NS Package Number MRA08B

30080740

## Ordering Information

Output Voltage	Order Number	Package Type	NSC Package Drawing	Supplied As
ADJ	LM22680MR-ADJ	PSOP-8 Exposed Pad	MRA08B	95 Units in Rails
ADJ	LM22680MRE-ADJ			250 Units in Tape and Reel
ADJ	LM22680MRX-ADJ			2500 Units in Tape and Reel

## Pin Descriptions

Pin	Name	Description	Application Information
1	BOOT	Bootstrap input	Provides the gate voltage for the high side NFET.
2	SS	Soft-start pin	An external capacitor and an internal 50 $\mu$ A current source set the time constant for the rise of the error amplifier reference. Pin can be left floating and internal soft-start will be default.
3	RT/SYNC	Oscillator frequency adjust pin or frequency synchronization	A resistor connected from this pin to GND adjusts the oscillator frequency. This pin can also accept an input for synchronization from an external clock. Pin can be left floating and internal setting will be default to 500 kHz.
4	FB	Feedback pin	Inverting input to the internal voltage error amplifier.
5	EN	Precision enable pin	When pulled low regulator turns off.
6	GND	System ground	Provide good capacitive decoupling between VIN and this pin.
7	VIN	Source input voltage	Input to the regulator. Operates from 4.5V to 42V.
8	SW	Switch pin	Attaches to the switch node.

**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 <sub>IN</sub> to GND	43V
EN Pin Voltage	-0.5V to 6V
SS, RT/SYNC Pin Voltage	-0.5V to 7V
SW to GND (Note 2)	-5V to V <sub>IN</sub>
BOOT Pin Voltage	V <sub>SW</sub> + 7V
FB Pin Voltage	-0.5V to 7V
Power Dissipation	Internally Limited
Junction Temperature	150°C

## Soldering Information

Vapor Phase (75 sec.)	219°C
Infrared (10 sec.)	240°C
Wave (4 sec.)	260°C

## ESD Rating (Note 3)

Human Body Model	±2 kV
Storage Temperature Range	-65°C to +150°C

**Operating Ratings** (Note 1)

Supply Voltage (V <sub>IN</sub> )	4.5V to 42V
Junction Temperature Range	-40°C to +125°C

**Electrical Characteristics**

Limits in standard type are for T<sub>J</sub> = 25°C only; limits in **boldface type** apply over the junction temperature (T<sub>J</sub>) range of -40°C to +125°C. Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at T<sub>A</sub> = T<sub>J</sub> = 25°C, and are provided for reference purposes only. Unless otherwise specified: V<sub>IN</sub> = 12V.

Symbol	Parameter	Conditions	Min (Note 5)	Typ (Note 4)	Max (Note 5)	Units
V <sub>FB</sub>	Feedback Voltage	V <sub>IN</sub> = 4.7V to 42V	1.266/ <b>1.259</b>	1.285	1.304/ <b>1.311</b>	V
I <sub>Q</sub>	Quiescent Current	V <sub>FB</sub> = 5V		3.4	<b>6</b>	mA
I <sub>STDBY</sub>	Standby Quiescent Current	EN Pin = 0V		25	40	μA
I <sub>CL</sub>	Current Limit		<b>TBD</b>	TBD	<b>TBD</b>	A
I <sub>L</sub>	Output Leakage Current	V <sub>IN</sub> = 42V, EN Pin = 0V, V <sub>SW</sub> = 0V		0.2	2	μA
		V <sub>SW</sub> = -1V		0.1	3	μA
R <sub>DS(ON)</sub>	Switch On-Resistance			0.2	0.24/ <b>0.32</b>	Ω
f <sub>O</sub>	Oscillator Frequency		<b>400</b>	500	<b>600</b>	kHz
T <sub>OFFMIN</sub>	Minimum Off-time			300		ns
T <sub>ONMIN</sub>	Minimum On-time			100		ns
I <sub>BIAS</sub>	Feedback Bias Current	V <sub>FB</sub> = 1.3V		230		nA
V <sub>EN</sub>	Enable Threshold Voltage		<b>1.3</b>	1.6	<b>1.9</b>	V
I <sub>EN</sub>	Enable Input Current	EN Input = 0V		6		μA
F <sub>SYNC</sub>	Synchronization Frequency	V <sub>SYNC</sub> = 3.5V, 50% duty-cycle		1		MHz
V <sub>SYNC</sub>	Synchronization Threshold Voltage			1.75		V
I <sub>SS</sub>	Soft-Start Current		<b>30</b>	50	<b>70</b>	μA
T <sub>SD</sub>	Thermal Shutdown Threshold			150		°C
θ <sub>JA</sub>	Thermal Resistance	MR Package, Junction to ambient temperature resistance (Note 6)		60		°C/W

**Note 1:** Absolute Maximum Ratings indicate limits beyond which damage to the device may occur, including inoperability and degradation of device reliability and/or performance. Functional operation of the device and/or non-degradation at the Absolute Maximum Ratings or other conditions beyond those indicated in the recommended Operating Ratings is not implied. The recommended Operating Ratings indicate conditions at which the device is functional and should not be operated beyond such conditions.

**Note 2:** The absolute maximum specification of the 'SW to GND' applies to DC voltage. An extended negative voltage limit of -10V applies to a pulse of up to 50 ns.

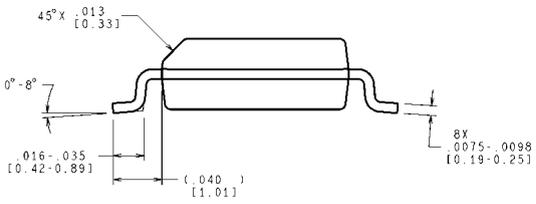
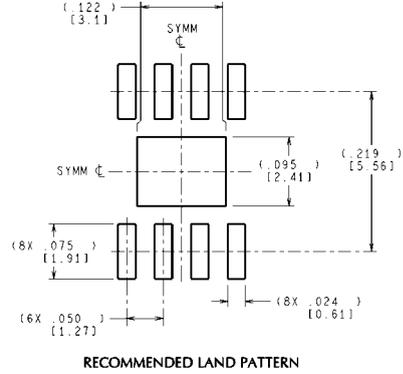
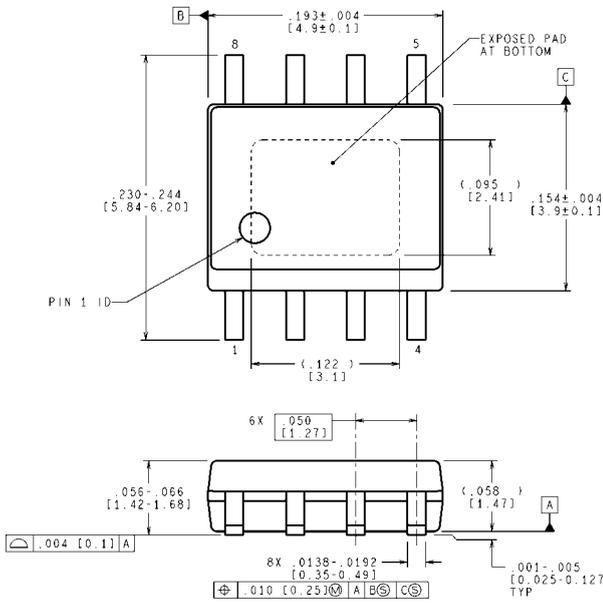
**Note 3:** ESD was applied using the human body model, a 100 pF capacitor discharged through a 1.5 k $\Omega$  resistor into each pin.

**Note 4:** Typical values represent most likely parametric norms at the conditions specified and are not guaranteed.

**Note 5:** 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).

**Note 6:** The value of  $\theta_{JA}$  for the PSOP-8 exposed pad (MR) package of 60°C/W is valid if package is mounted to 1 square inch of copper. The  $\theta_{JA}$  value can range from 42 to 115°C/W depending on the amount of PCB copper dedicated to heat transfer.

**Physical Dimensions** inches (millimeters) unless otherwise noted



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 VALUES IN [ ] ARE MILLIMETERS  
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**8-Lead Plastic PSOP-8 Package  
 NS Package Number MRA08B**

MRA08B (Rev B)

## Notes

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LVDS	<a href="http://www.national.com/lvds">www.national.com/lvds</a>	Reference Designs	<a href="http://www.national.com/refdesigns">www.national.com/refdesigns</a>
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Switching Regulators	<a href="http://www.national.com/switchers">www.national.com/switchers</a>		
LDOs	<a href="http://www.national.com/lido">www.national.com/lido</a>		
LED Lighting	<a href="http://www.national.com/led">www.national.com/led</a>		
PowerWise	<a href="http://www.national.com/powerwise">www.national.com/powerwise</a>		
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