

MAXIM

3V to 5V Regulating Charge Pumps for SIM Cards

General Description

The MAX1686 provides power for dual-voltage subscriber ID module (SIM) cards in portable applications such as GSM cellular phones. Designed to reside in the portable unit (cellular phone handset), the 1MHz charge pump converts a 2.7V to 4.2V input to regulated 5V output. The MAX1686H has a nominal output voltage of 5.0V, while the MAX1686 is set to 4.75V to reduce SIM-card current drain. The charge pump has only 45µA quiescent supply current, which reduces to 3µA when a 3V-capable SIM card is being powered and the charge pump is disabled. An internal input/output shorting switch provides power for 3V SIM cards.

The MAX1686/MAX1686H require only three external capacitors around their space-saving, thin (1mm) 8-pin µMAX packages.

Applications

GSM Cellular Phones

PCS Phones

Portable POS Terminals

Personal Communicators

Features

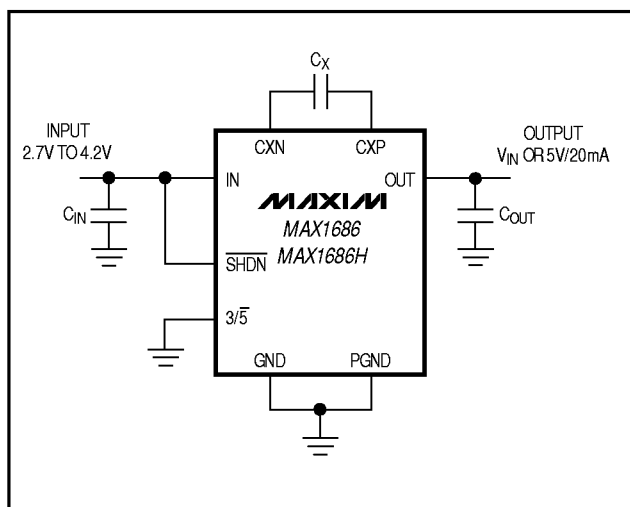
- ♦ 2.7V to 4.2V Input Range
- ♦ 12mA min Charge-Pump Output Current
- ♦ 45µA Quiescent Supply Current
- ♦ 0.1µA Supply Current in Shutdown Mode
- ♦ 5.0V Regulated Charge-Pump Output (MAX1686H)
4.75V Regulated Charge-Pump Output (MAX1686)
- ♦ Input-Output Shorting Switch for 3V Cards
- ♦ Small External Components
(Uses a 0.047µF, 0.1µF, and a 2.2µF Capacitor)
- ♦ Output Driven to Ground in Shutdown Mode
- ♦ Super-Small 8-Pin µMAX Package
- ♦ Soft-Start and Short-Circuit Protection

MAX1686/MAX1686H

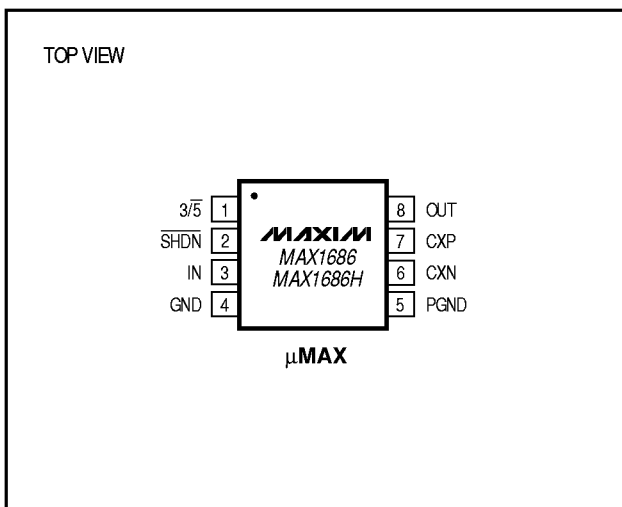
Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MAX1686EUA	-40°C to +85°C	8 µMAX
MAX1686HEUA	-40°C to +85°C	8 µMAX

Typical Operating Circuit



Pin Configuration



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ABSOLUTE MAXIMUM RATINGS

IN, OUT, $\overline{\text{SHDN}}$, 3/5 to GND.....-0.3V to +6V
 CXP to GND.....-0.3V to ($V_{\text{OUT}} + 0.3\text{V}$)
 CXN to GND.....-0.3V to ($V_{\text{IN}} + 0.3\text{V}$)
 PGND to GND.....-0.3V to + 0.3V
 OUT Short Circuit to GND.....Continuous
 IN-to-OUT Current.....50mA

Continuous Power Dissipation ($T_A = +70^\circ\text{C}$)
 8-Pin μMAX (derate 4.1mW/ $^\circ\text{C}$ above $+70^\circ\text{C}$)330mW
 Operating Temperature Range
 MAX1686EUA/MAX1686HEUA.....-40 $^\circ\text{C}$ to $+85^\circ\text{C}$
 Junction Temperature.....+150 $^\circ\text{C}$
 Storage Temperature Range.....-65 $^\circ\text{C}$ to $+165^\circ\text{C}$
 Lead Temperature (soldering, 10sec).....+300 $^\circ\text{C}$

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

($V_{\text{IN}} = V_{\overline{\text{SHDN}}} = 3.3\text{V}$, 3/5 = GND, $C_X = 0.22\mu\text{F}$, $C_{\text{OUT}} = 10\mu\text{F}$ (see *Applications Information* section to use smaller capacitors), $T_A = T_{\text{MIN}}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.) (Note 1)

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Input Voltage Range			2.7		4.2	V
Input Undervoltage-Lockout Threshold Voltage			0.8	1.2	1.6	V
Quiescent Supply Current	Charge pump enabled, no load, 3/5 = GND	T _A = +25°C	45		100	μA
		T _A = -40°C to +85°C	150			
	Charge pump disabled, no load, 3/5 = IN		3	10		
Shutdown Supply Current	V _{IN} = 3.6V, SHDN = GND		0.1	5	μA	
OUT Output Voltage	V _{IN} = 2.7V to 4.2V, load = 0 to 12mA	MAX1686	4.55	4.75	5.25	V
		MAX1686H	4.75	5.00	5.25	
	3/5 = IN		V _{IN}			
IN-to-OUT Switch On-Resistance	V _{3/5} = V _{IN} = 3.0V		2.5	5	Ω	
OUT Discharge Switch On-Resistance	3/5 = GND or IN, SHDN = GND		80	200	Ω	
OUT Short-Circuit Current	3/5 = GND or IN		20	100	200	mA
Logic Input Low Voltage	SHDN, 3/5		0.5 · V _{IN}		0.3 · V _{IN}	V
Logic Input High Voltage	SHDN, 3/5		0.7 · V _{IN}	0.5 · V _{IN}		V
Logic Input Leakage Current	SHDN, 3/5 = GND or IN		0.1	1	μA	
Charge-Pump Frequency	T _A = +25°C		800	1000	1200	kHz
	T _A = -40°C to +85°C		700	1300		

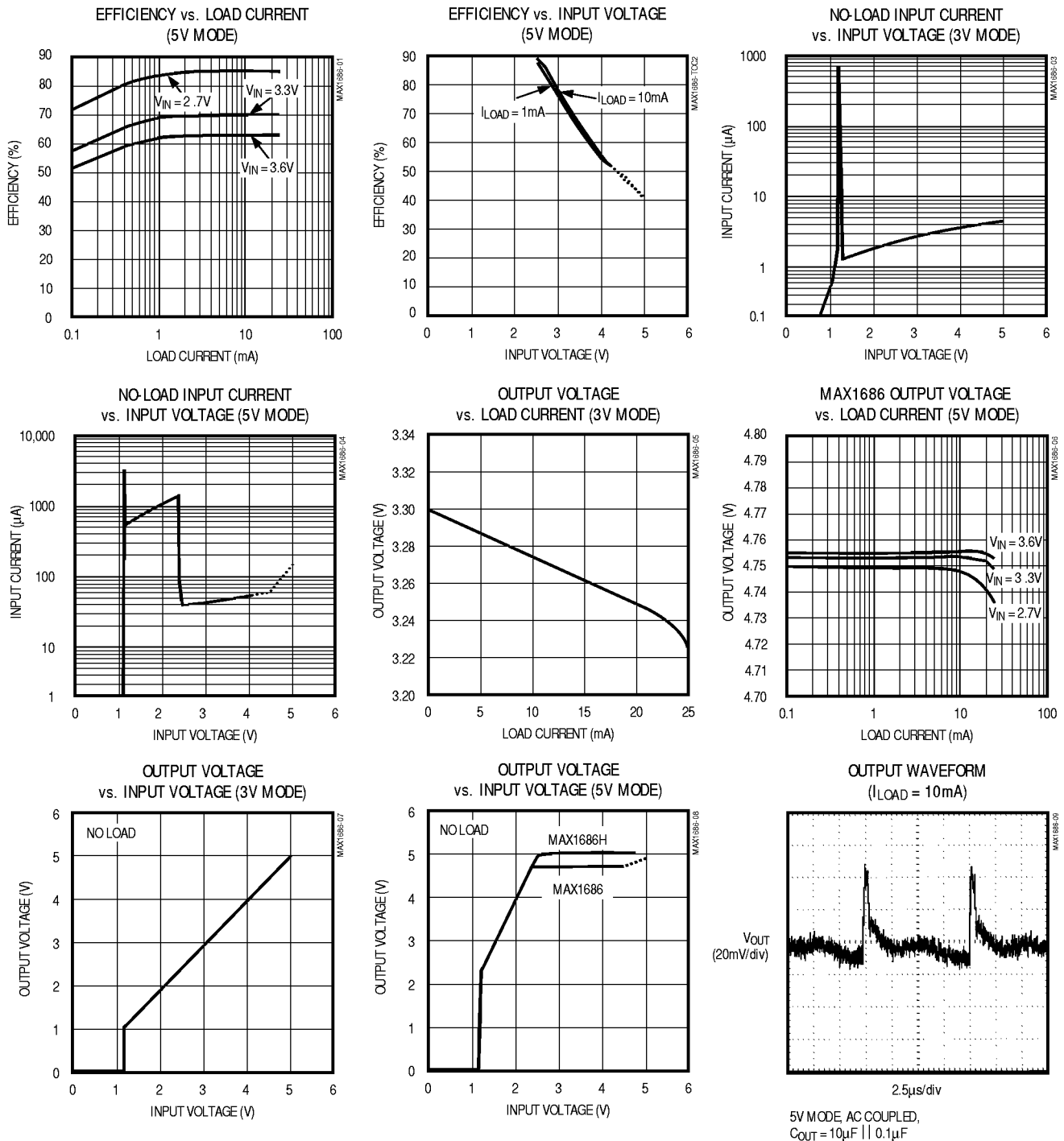
Note 1: Electrical specifications are measured by pulse testing and are guaranteed for a junction temperature within the operating temperature range, unless otherwise noted. Limits are 100% production tested at $T_A = +25^\circ\text{C}$. Limits over the entire operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods and are not production tested.

3V to 5V Regulating Charge Pumps for SIM Cards

Typical Operating Characteristics

(See Typical Operating Circuit, $C_{IN} = 0.47\mu F$, $C_X = 0.22\mu F$, $C_{OUT} = 10\mu F$, $V_{IN} = 3.3V$, $T_A = +25^\circ C$, unless otherwise noted.)

MAX1686/MAX1686H

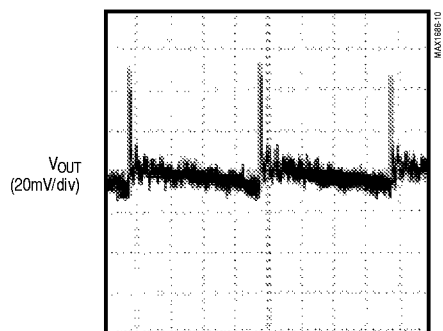


3V to 5V Regulating Charge Pumps for SIM Cards

Typical Operating Characteristics (continued)

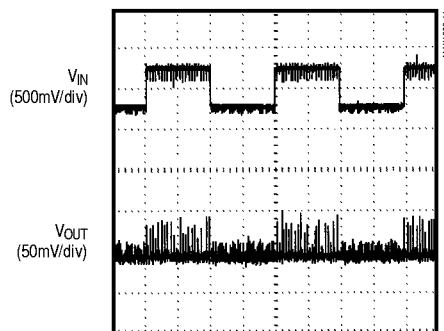
(See Typical Operating Circuit, $C_{IN} = 0.47\mu F$, $C_X = 0.22\mu F$, $C_{OUT} = 10\mu F$, $V_{IN} = 3.3V$, $T_A = +25^\circ C$, unless otherwise noted.)

OUTPUT WAVEFORM
($I_{LOAD} = 1mA$)



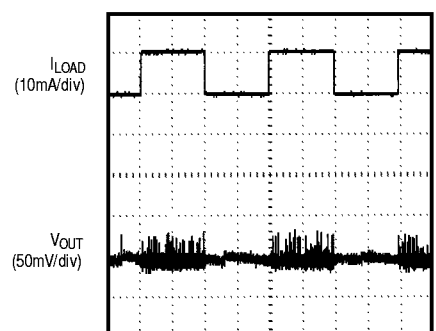
5V MODE, AC COUPLED,
 $C_{OUT} = 10\mu F || 0.1\mu F$

LINE-TRANSIENT RESPONSE



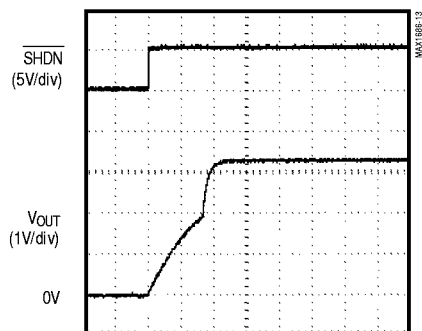
$V_{IN} = 2.8V$ to $3.3V$, $I_{LOAD} = 10mA$, 5V MODE,
AC COUPLED

LOAD-TRANSIENT RESPONSE

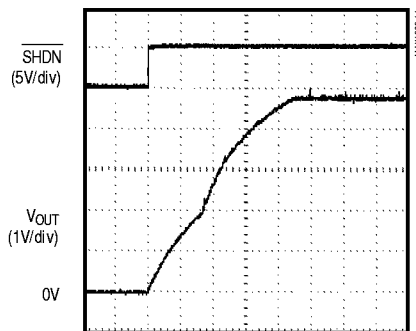


$I_{LOAD} = 0$ TO $10mA$, 5V MODE, AC COUPLED

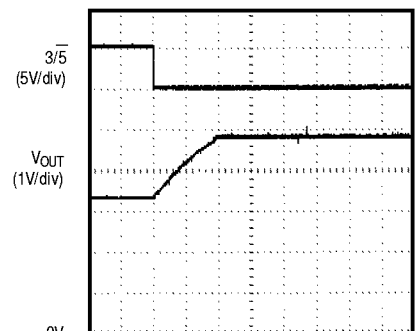
START-UP WAVEFORM
(3V MODE, $R_L = 500\Omega$)



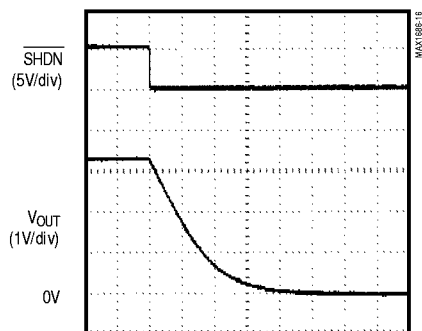
START-UP WAVEFORM
(5V MODE, $R_L = 500\Omega$)



3V MODE TO 5V MODE
WAVEFORM ($R_L = 500\Omega$)



SHUTDOWN WAVEFORM
(3V MODE, NO LOAD)



$R_L = 500\Omega$

SHUTDOWN WAVEFORM
(5V MODE, NO LOAD)

