



钜地半导体
Tudi Semiconductor

Product Specification

TUDI-MAX660MX

Switched Capacitor Voltage Converter

网址 www.sztdbdt.com Q

用芯智造 · 卓越品质

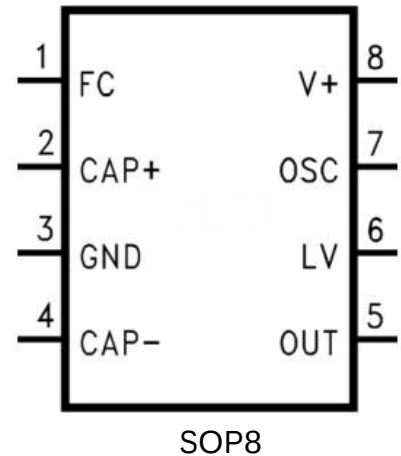
**semiconductor device
manufacturer**

- Design
- research and development
- production
- and sales



Features

- Inverts or Doubles Input Supply Voltage
- Narrow SO-8 Package
- 6.5- Ω Typical Output Resistance
- 88% Typical Conversion Efficiency at 100 mA
- Selectable Oscillator Frequency: 10 kHz/80 kHz



Description

The MAX660 CMOS charge-pump voltage converter is a versatile unregulated switched-capacitor inverter or doubler. Operating from a wide 1.5-V to 5.5-V supply voltage, the MAX660 uses two low-cost capacitors to provide 100 mA of output current without the cost, size and EMI related to inductor-based converters. With an operating current of only 120 μ A and operating efficiency greater than 90% at most loads, the MAX660 provides ideal performance for battery-powered systems. MAX660 devices can be operated directly in parallel to lower output impedance, thus providing more current at a given voltage.

The FC (frequency control) pin selects between a nominal 10-kHz or 80-kHz oscillator frequency. The oscillator frequency can be lowered by adding an external capacitor to the OSC pin. Also, the OSC pin may be used to drive the MAX660 with an external clock up to 150 kHz. Through these methods, output ripple frequency and harmonics may be controlled.

Additionally, the MAX660 may be configured to divide a positive input voltage precisely in half. In this mode, input voltages as high as 11 V may be used.

Applications

- Laptop Computers
- Cellular Phones
- Medical Instruments
- Operational Amplifier Power Supplies
- Interface Power Supplies
- Handheld Instruments



Pin Functions

PIN		V/O	DESCRIPTION	
NAME	NO.		VOLTAGE INVERTER	VOLTAGE DOUBLER
CAP+	2	Power	Connect this pin to the positive terminal of charge-pump capacitor.	Same as inverter
CAP-	4	Power	Connect this pin to the negative terminal of charge-pump capacitor.	Same as inverter
FC	1	Input	Frequency control for internal oscillator:FC = open, $f_{osc}=10\text{ kHz}$ (typical); FC=V+, $f_{osc}=80\text{ kHz}$ (typical);FC has no effect when OSC pin is driven externally	Same as inverter
GND	3	Ground	Power supply ground input.	Power supply positive voltage input
LV	6	Input	Low-voltage operation input.Tie LV to GND when input voltage is less than 3.5V.Above 3.5V,LV can be connected to GND or left open.When driving OSC with an external clock,LV must be connected to GND.	LV must be tied to OUT.
OSC	7	Input	Oscillator control input.OSC is connected to an internal 15-pF capacitor.An external capacitor can be connected to slow the oscillator.Also,an external clock can be used to drive OSC.	Same as inverter except that OSC cannot be driven by an external clock
OUT	5	Power	Negative voltage output	Positive supply ground input
V+	8	Power	Power supply positive voltage input	Positive voltage output



Specifications

Absolute Maximum Ratings

	MIN	MAX	UNIT
Supply voltage(V+to GND,or GND to OUT)		6	V
LV	(OUT-0.3 V)	(GND+3V)	
FC,OSC	The least negative of (OUT-0.3 V)(V+ -6V)to (V+0.3V)		
V+and OUT continuous output current		120	mA
Output short-circuit duration to GND(3)		1	sec
Power dissipation,T _A =25°C(4)		735	mW
T _J ,maximum(4)		150	°C
Operating junction temperature	-40	85	°C
Storage temperature,T _{stg}	-65	150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) If Military/Aerospace specified devices are required, contact the Texas Instruments Sales Office/ Distributors for availability and specifications.

(3) OUT may be shorted to GND for one second without damage. However, shorting OUT to V+ may damage the device and must be avoided. Also, for temperatures above 85°C, OUT must not be shorted to GND or V+, or device may be damaged.

(4) The maximum allowable power dissipation is calculated by using $P_{D_MAX} = (T_{J_MAX} - T_A) / R_{\theta JA}$, where T_{J_MAX} is the maximum junction temperature, T_A is the ambient temperature, and $R_{\theta JA}$ is the junction-to-ambient thermal resistance of the specified package.

ESD Ratings

		VALUE	UNIT
V _(ESD) Electrostatic discharge	Human-body model(HBM),per ANSI/ESDA/JEDEC JS-001(1)	±2000	V

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.



Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V+(supply voltage)	Inverter,LV=open	3.5		5.5	V
	Inverter,LV=GND	1.5		5.5	
	Doubler,LV=out	2.5		5.5	
Junction temperature(T _J)		-40		85	°C

Thermal Information

THERMAL METRIC		MAX660	UNIT
		SOIC(D)	
		8 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	114.4	°C/W
R _{θJC(top)}	Junction-to-case (top)thermal resistance	61.4	°C/W
R _{θJB}	Junction-to-board thermal resistance	55.5	°C/W
ψ _{JT}	Junction-to-top characterization parameter	9.8	°C/W
ψ _{JB}	Junction-to-board characterization parameter	54.9	°C/W

Electrical Characteristics

Unless otherwise specified: Limits apply for T_J = 25°C, V+ = 5 V, FC = open, C1 = C2 = 150 μF.⁽¹⁾

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
V+ ⁽²⁾ Supply voltage	R _L =1 kΩ	Inverter LV=open(3),T _J = -40°C to 85°C	3.5		5.5	V
		Inverter,LV=GND,T _J = -40°C to 85°C	1.5		5.5	
		Doubler,LV=OUT,T _J = -40°C to 85°C	2.5		5.5	



Electrical Characteristics (Continued)

Unless otherwise specified: Limits apply for $T_J = 25^\circ\text{C}$, $V_+ = 5\text{ V}$, $\text{FC} = \text{open}$, $\text{C1} = \text{C2} = 150\text{ }\mu\text{F}$.⁽¹⁾

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_Q Supply current	No load, LV = open	FC=open		0.12		mA
		FC=open, $T_J = -40^\circ\text{C}$ to 85°C			0.5	
		FC=V+		1		
		FC=V+, $T_J = -40^\circ\text{C}$ to 85°C			3	
I_L Output current	$T_A \leq 85^\circ\text{C}$, OUT $\leq -4\text{ V}$		100			mA
	$T_A > 85^\circ\text{C}$, OUT $\leq -3.8\text{ V}$		100			
R_{OUT} Output resistance ⁽²⁾	$I_L = 100\text{ mA}$	$T_A \leq 85^\circ\text{C}$		6.5	10	Ω
		$T_J = -40^\circ\text{C}$ to 85°C			10	
		$T_A > 85^\circ\text{C}$, $T_J = -40^\circ\text{C}$ to 85°C			12	
f_{OSC} Oscillator frequency	OSC=open	FC=open		10		kHz
		FC=open, $T_J = -40^\circ\text{C}$ to 85°C	5			
		FC=V+		80		
		FC=V+, $T_J = -40^\circ\text{C}$ to 85°C	40			
I_{OSC} OSC input current	FC=open			± 2		μA
	FC=V+			± 16		
P_{EFF} Power efficiency	$R_L(1\text{ k}\Omega)$ between V+ and OUT			98%		
	$R_L(1\text{ k}\Omega)$ between V+ and OUT $T_J = -40^\circ\text{C}$ to 85°C		96%			
	$R_L(500\text{ }\Omega)$ between GND and OUT			96%		
	$R_L(500\text{ }\Omega)$ between GND and OUT $T_J = -40^\circ\text{C}$ to 85°C		92%			
	$I_L = 100\text{ mA}$ to GND			88%		
V_{OEFF} Voltage conversion efficiency	No load			99.96 %		
	No load, $T_J = -40^\circ\text{C}$ to 85°C		99%			

(1) In the test circuit, capacitors C1 and C2 are 0.2- Ω maximum ESR capacitors. Capacitors with higher ESR increase output resistance, reduce output voltage, and efficiency.

(2) Specified output resistance includes internal switch resistance and capacitor ESR.

(3) The minimum limit for this parameter is different from the limit of 3 V for the industry-standard 660 product. For inverter operation with supply voltage below 3.5 V, connect the LV pin to GND.

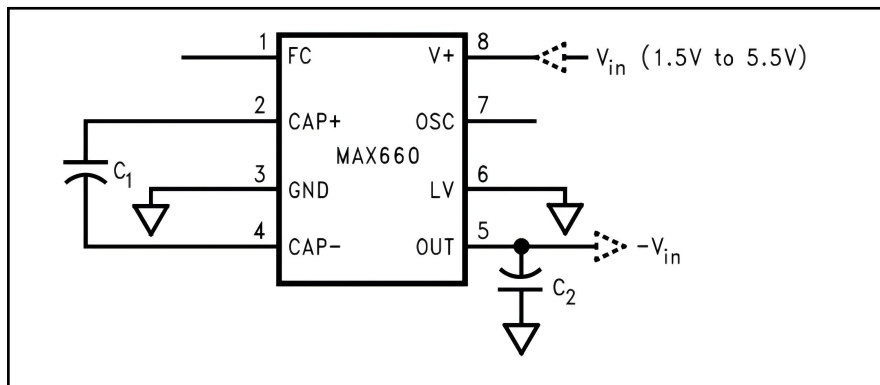


Figure 1. Voltage Inverter

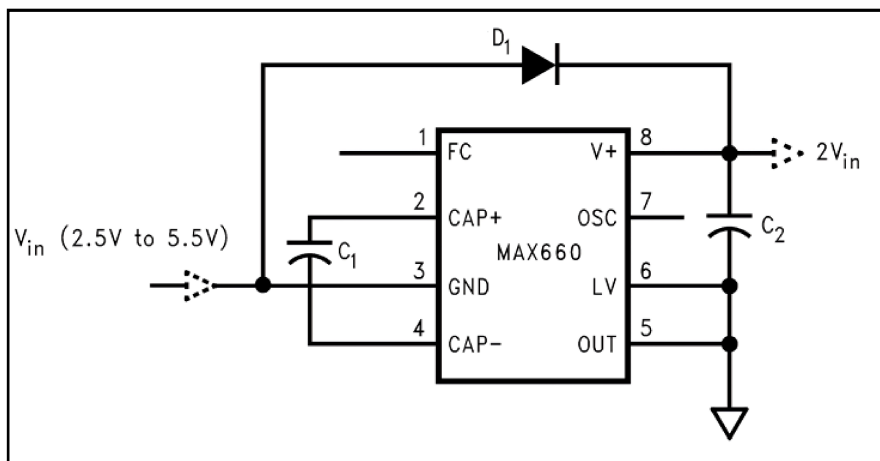


Figure 2. Positive Voltage Doubler

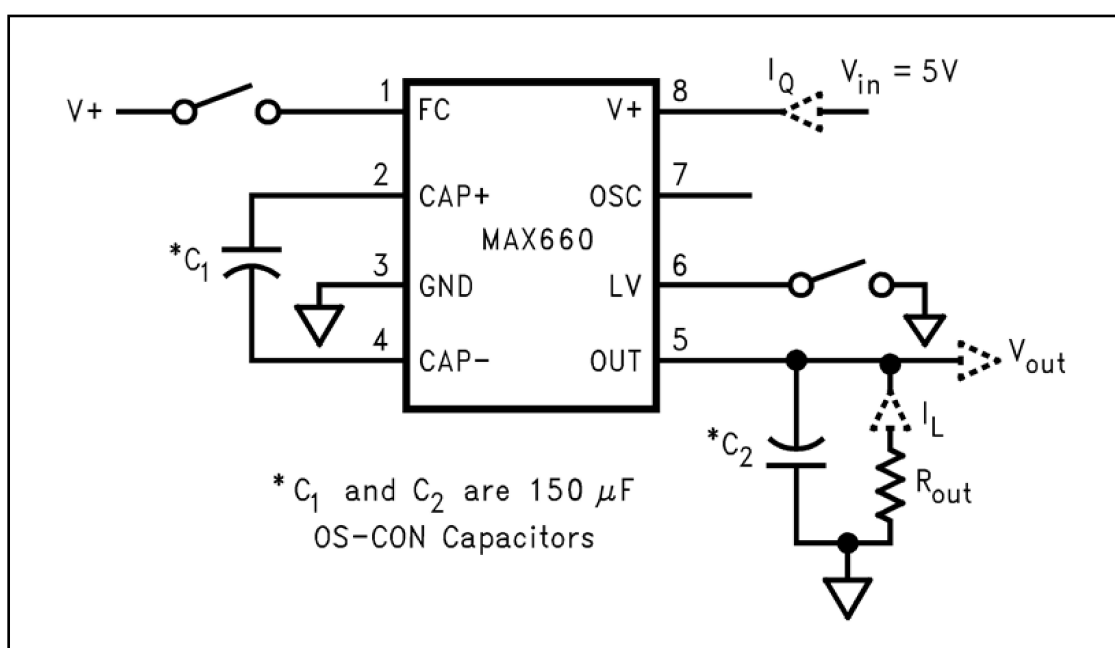


Figure 3. MAX660 Test Circuit



Order information

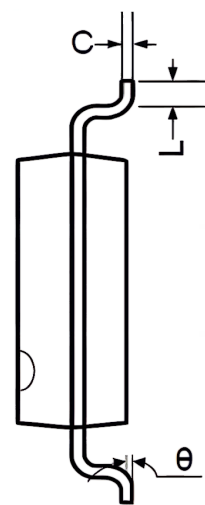
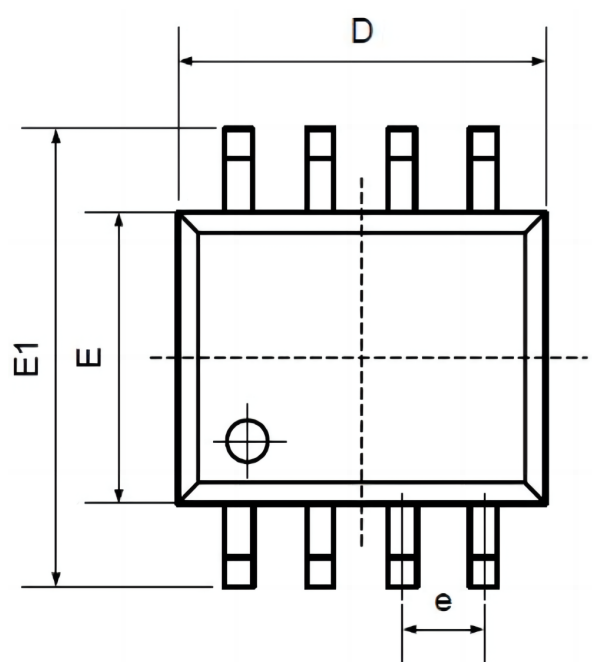
Order Number	Package	Package Quantity	Marking On The park	Temperature
MAX660MX-TUDI	SOP8	Tape,Reel,4000	MAX660MX	-40°C to +85°C
			MAX660M	

Revision history

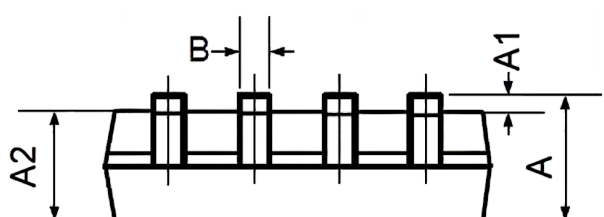
	Date	Revision	Page
V1.0	2020/4	New	1-12
V1.1	2025-7	Update model and PDF template	1-10



Package SOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°





Important statement:

- TUDI Semiconductor reserves the right to modify the product manual without prior notice! Before placing an order, customers need to confirm whether the obtained information is the latest version and verify the completeness of the relevant information.
- Any semi-guide product is subject to failure or malfunction under specified conditions. It is the buyer's responsibility to comply with safety standards when using TUDI Semiconductor products for system design and whole machine manufacturing. And take the appropriate safety measures to avoid the potential in the risk of loss of personal injury or loss of property situation!
- TUDI Semiconductor products have not been licensed for life support, military, and aerospace applications, and therefore TUDI Semiconductor is not responsible for any consequences arising from the use of this product in these areas.
- If any or all TUDI Semiconductor products (including technical data, services) described or contained in this document are subject to any applicable local export control laws and regulations, they may not be exported without an export license from the relevant authorities in accordance with such laws.
- The specifications of any and all TUDI Semiconductor products described or contained in this document specify the performance, characteristics, and functionality of said products in their standalone state, but do not guarantee the performance, characteristics, and functionality of said products installed in Customer's products or equipment. In order to verify symptoms and conditions that cannot be evaluated in a standalone device, the Customer should ultimately evaluate and test the device installed in the Customer's product device.
- TUDI Semiconductor documentation is only allowed to be copied without any alteration of the content and with the relevant authorization. TUDI Semiconductor assumes no responsibility or liability for altered documents.
- TUDI Semiconductor is committed to becoming the preferred semiconductor brand for customers, and TUDI Semiconductor will strive to provide customers with better performance and better quality products.