Charge Pump
DC-DC Voltage Converter

CE7660

CE7660 is a charge pump dc-to-dc voltage converter using Si-gate CMOS technology and optimization design. It converters a +2.5V to +10V input to a corresponding -2.5V to -10V output using only two external capacitors, eliminating inductors and their associated cost, size and EMI. The on-board oscillator operates at a nominal frequency of 10KHz. Operation below 10 KHz (for lower supply current applications) is possible by connecting an external capacitor from OSC to ground.

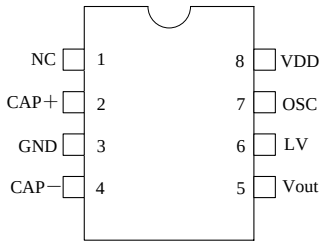
Features

- Wide input voltage range: 2.5V~10V
- Efficient voltage conversion:99.9%
- Good power efficiency: 98%
- Low power supply: 50uA @5V input
- Easy to use: only two external capacitors required
- Compatible with RS232 negative power supply standard
- High ESD protection: up to 4KV
- No Dx diode needed for high voltage operation
- Package : SOP8, DIP8

Applications

- LCD Display Module
- Specially designed for LCD module
- Instrument product
- RS-232 Power supply
- Operation amplifier supply
- On board negative supply for dynamic RAMS

Pin Configuration

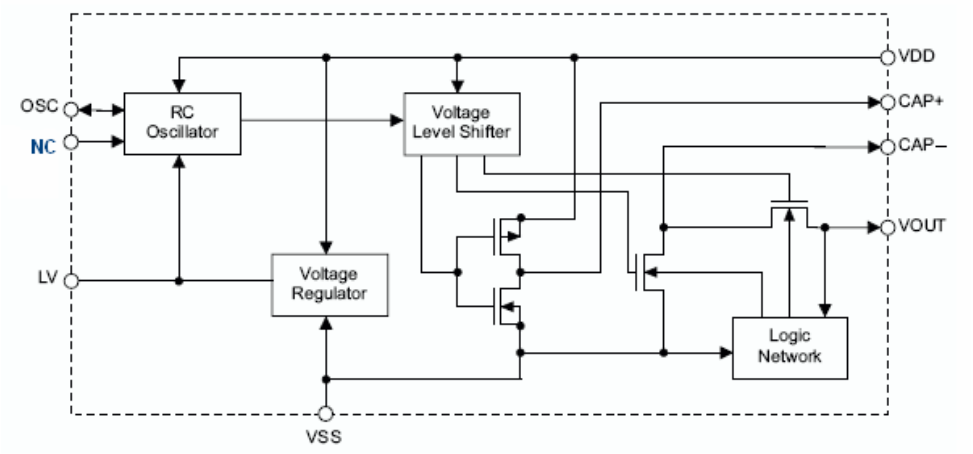


CE7660
DIP8 / SOP8

Pin Description

PIN Number	PIN NAME	FUNCTION
1	NC	No connection
2	CAP^+	Connecting external capacitor(+) pin
3	GND	Ground pin
4	CAP^-	Connecting external capacitor(-) pin
5	Vout	Voltage output pin
6	LV	Low voltage selection pin
7	OSC	Connecting oscillation capacitor pin
8	VDD	Power supply pin

Block Diagram



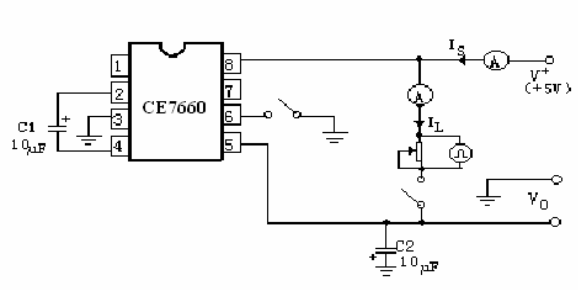
Absolute Maximum Ratings

PARAMETER		SYMBOL	RATINGS	UNITS
Input voltage		V_{IN}	+13V	V
LV PIN input voltage		V_{LX}	-0.3～(V^++0.3)（if V^+<5.5V）	V
OSC PIN input voltage		V_{OSC}	(V^+-5.5V)～(V^++0.3V)（if V^+>5.5V）	
Output Short Duration (Vsupply ≤5.5V)			∞	
ContinuousTotal Power Dissipation（T_A≤75℃）	SOP8	Pd	470	mW
	DIP8	Pd	730	mW
Operating Ambient Temperature		T_{Opr}	-40~+85	℃
Storage Temperature		T_{stg}	-65~+150	℃
Soldering temperature and time		T_{solder}	260℃, 10s	

Electrical Characteristics(VDD=5V,C_{OSC}=0)

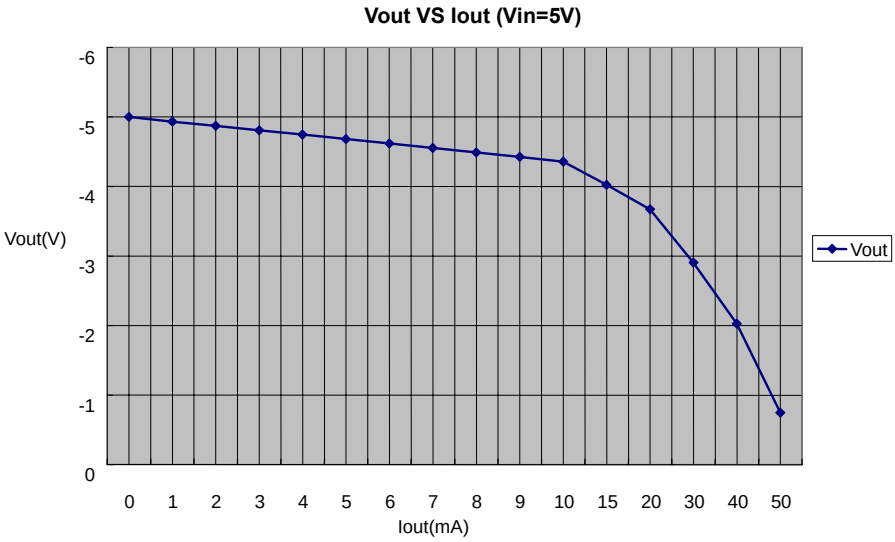
Symbol	Item	Conditions	Min	Typ	Max	Unit
I^+	Supply Current	R_L=∞	—	50	100	μA
VDD	Supply Voltage		2.5	—	10	V
R_{OUT}	Output Resistance	I_{OUT}=20mA T_A=25℃		60		Ω
F_{OSC}	Oscillator Frequency	Pin 7 open	—	10	—	kHz
P_{EFF}	Power Efficiency	R_L=5kΩ	95	98	—	%
$V_{OUT}E_{FF}$	Voltage Conversion Efficiency	R_L=∞	98	99.9	—	%

Test Circuits

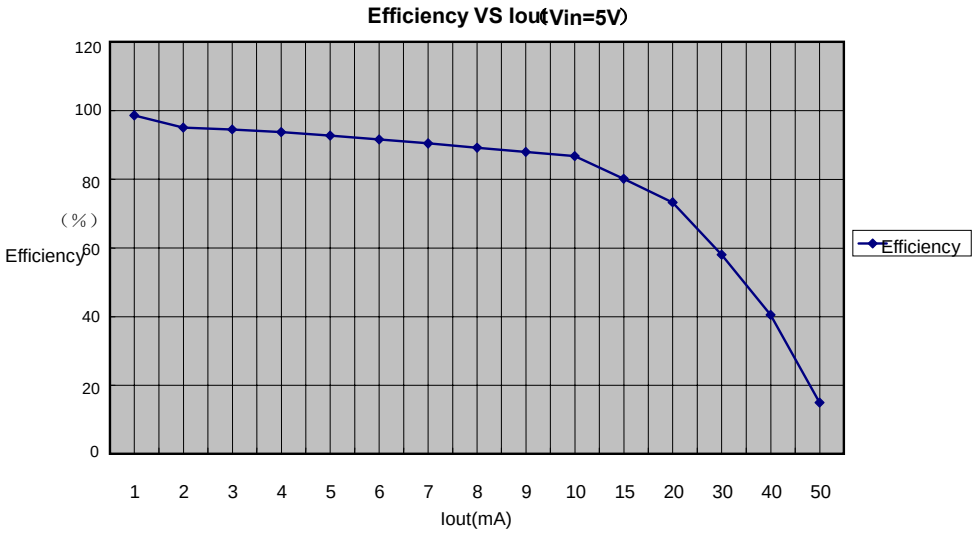


Type Characteristics

1. Vout VS Iout:

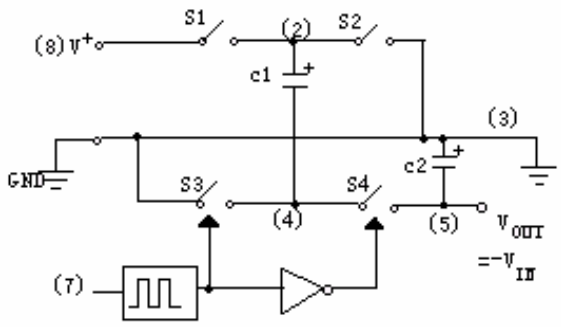


2. η VS Iout:



Operation

CE7660 together with two external capacitors C1、C2 complement a voltage Inverter. Capacitor C1 is charged to a voltage V^+, for the first half cycle when switches S1 and S3 are closed (while switches S2 and S4 are open during this half cycle); During the second half cycle of operation, switches S2 and S4 are closed, with S1 and S3 open, thereby shifting capacitor C2 negatively to $-V^+$.



Charge Pump Voltage Converter operating process

Theoretical Power Efficiency Considerations

In theory, a capacitive charge pump can approach 100% efficiency if certain conditions are met:

1、 The drive circuitry consumes no power.

2、 The output switches have extremely low ON resistance and no offset when operation.

3、 The impedances of the pump and reservoir capacitors are negligible at the pump frequency.

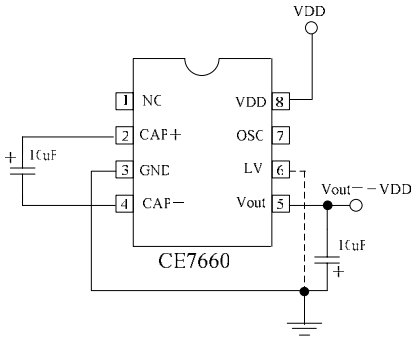
Notes:

1、Supply voltage should not exceed maximum rating;

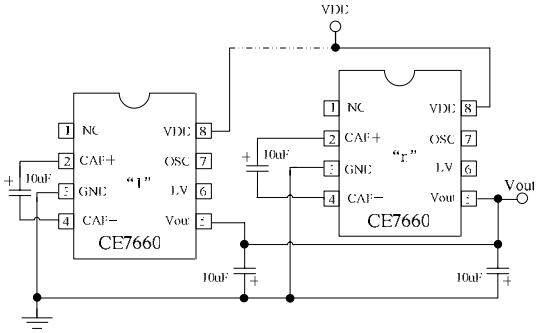
2、Do not short the output to VDD supply for voltages above 5.5V for extended periods;

3、Polarized capacitors should be connected as the figure above.

Typical Application

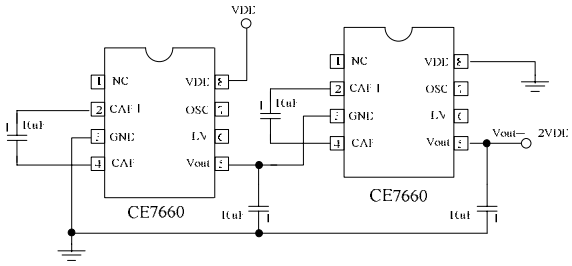


Above figure is the basic application circuit to provide a negative supply from -2.5V~ -10V while a positive supply from +2.5V ~ +10V is available. When VDD=+5V, the output resistance is about 60Ω; The output voltage is –4.5V while the load current is 10mA.

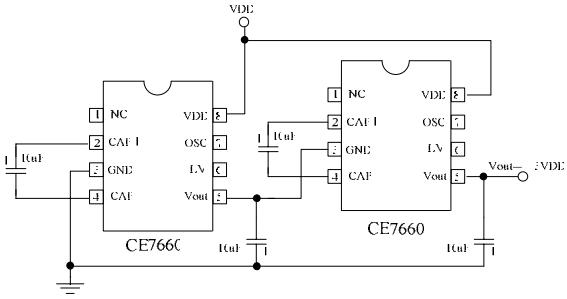


CE7660 may be paralleled to reduce output resistance (see the above figure)

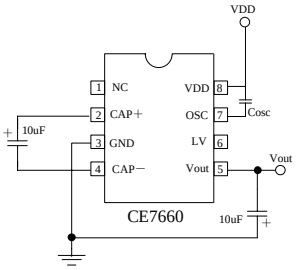
Rout(Paralleled)=Rout/N



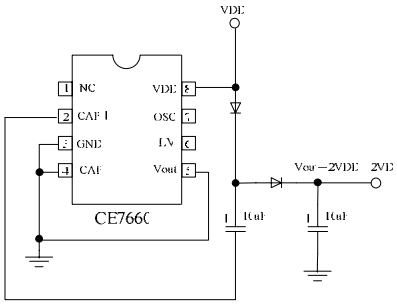
CE7660 may be cascaded as shown above to produce larger negative output voltage (-10V). However, The output resistance is approximately double that of a single chip resistance.



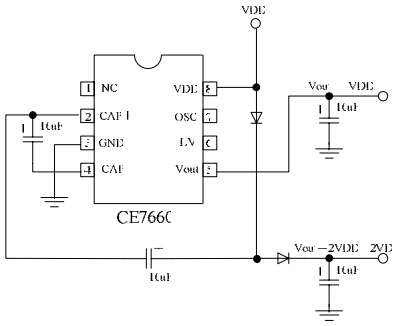
CE7660 may be cascaded as shown above to produce larger negative output voltage (-15V). However, The output resistance is approximately double that of a single chip resistance.



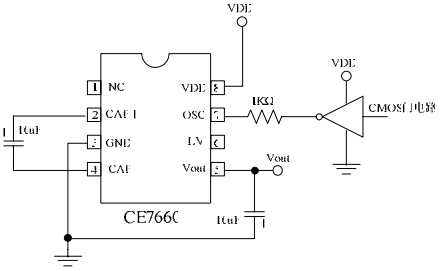
To increase the conversion efficiency, the oscillator frequency may be lowered by connecting a capacitor from pin 7 and pin 8 as shown above.



CE7660 may be applied to achieve positive voltage multiplication using the circuit shown in the above figure



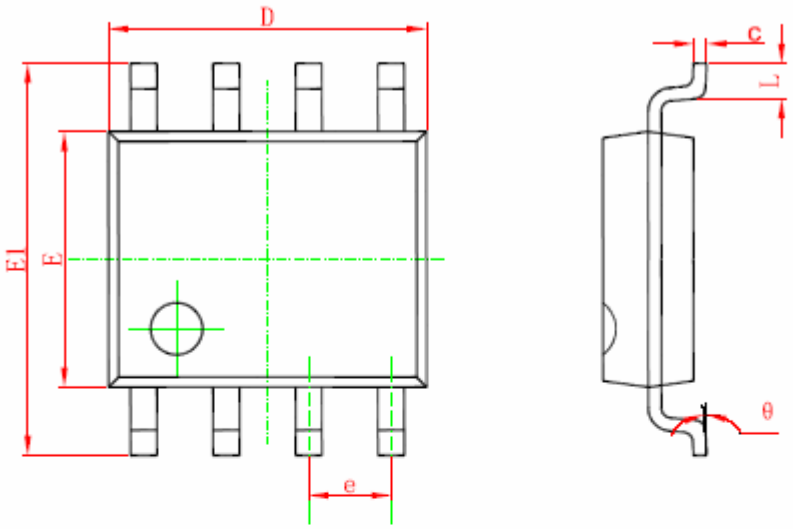
In above figure, C1、C3 are the pump and reservoir capacitors respectively for the generation of the negative voltage; C2、C4 are the pump and reservoir capacitors respectively for the multiplied positive voltage. When +5V supply is provided, +9V and -5V can be generated.



In some noise-sensitive applications, it may be desirable to increase the oscillator frequency. This can be achieved by overdriving the oscillator from an external clock as shown in the above figure. The external clock output should connect a 1kΩ resistor to prevent device latch-up. Besides, the pump frequency will be half of the clock frequency because of the internal circuit.

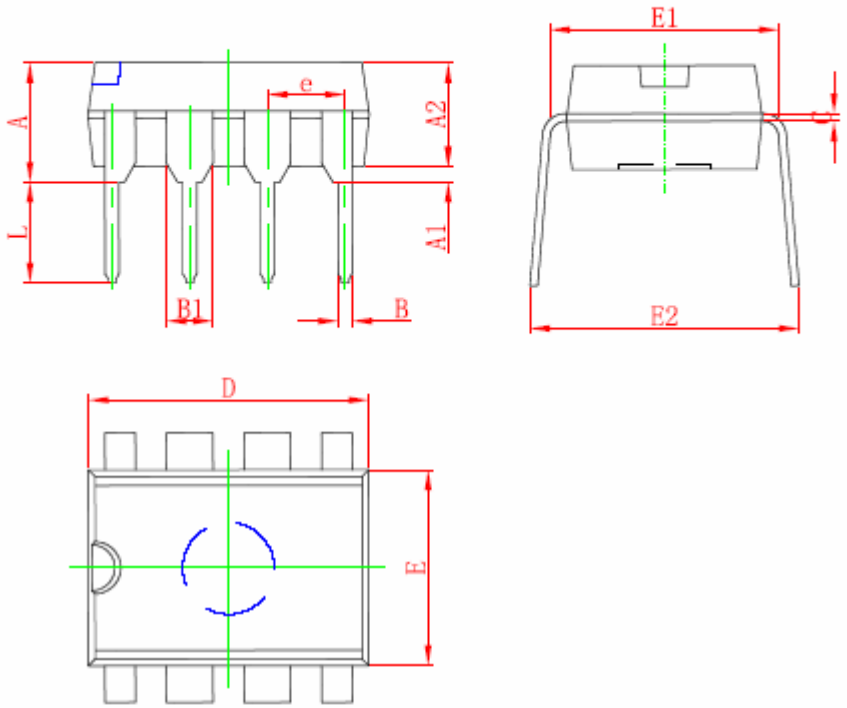
Package Diomensions

SOP8 PACKAGE OUTLINE DIMENSIONS



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	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

DIP8 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	4.310	0.146	0.170
A1	0.510		0.020	
A2	3.200	3.600	0.126	0.142
B	0.380	0.570	0.015	0.022
B1	1.524(BSC)		0.060(BSC)	
C	0.204	0.360	0.008	0.014
D	9.000	9.400	0.354	0.370
E	6.200	6.600	0.244	0.260
E1	7.320	7.920	0.288	0.312
e	2.540(BSC)		0.100(BSC)	
L	3.000	3.600	0.118	0.142
E2	8.400	9.000	0.331	0.354