Switched-Capacitor Voltage Converter

FEATURES

Low output impedance (typ. 35Ω at
   V_{IN}=5V)

Improved direct replacement for 7660

Operation from 1.5V to 6V

No external diode required

Simple conversion from +5V to -5V

Low quiescent current (typ. 36µA at V_{IN}=5V)

High power efficiency (typ. 98%)

Boost pin for higher switching frequency

Improved SCR latchup protection

APPLICATIONS

RS-232 Power Supplies

Handheld Instruments

Data Acquisition Systems

Supply Splitter $V_{OUT} = \pm V_{IN}/2$

Operational Amplifier Supplies

Panel Meter

TYPICAL APPLICATION CIRCUIT

Negative voltage converter
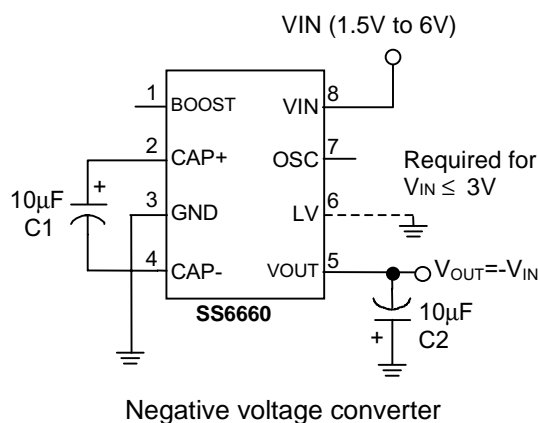
DESCRIPTION

The SS6660 is a monolithic CMOS switched-capacitor voltage converter. Designed to be an improved direct replacement for the popular 7660 and LTC1044, the main function of the SS6660 is to convert a positive input voltage in the range of 1.5V to 6V to the corresponding negative output voltage in the range of 11.5V to -6V.
The input voltage can also be doubled (V_{OUT} = 2V_{IN}), divided (V_{OUT} = V_{IN}/2), or multiplied (V_{OUT} = ±nV_{IN}) as shown in the application examples.

The chip contains a series DC power supply regulator, oscillator, control circuitry and four output power MOSFET switches. The frequency of the oscillator can be lowered by the addition of an external capacitor to the OSC pin, or the oscillator may be over-driven by an external clock.

This boost function is available to raise the oscillator frequency to optimize performance in specific applications. The "LV" terminal may be tied to GND to improve low input-voltage (V_{IN} ≤ 3V) operation, or be left floating for input voltages larger than 3V to improve power dissipation.

The SS6660 provides performance superior to previous designs by combining low output impedance, low quiescent current with high efficiency and by eliminating losses from diode voltage drops. The only external components required are two low-cost electrolytic capacitors.
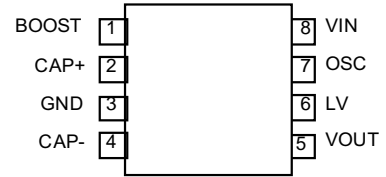
ORDERING INFORMATION

SS6660CX<u>XX</u>

Packing type
TR: Tape and reel
TB: Tube

Package type:
N: Plastic DIP
S: Small outline
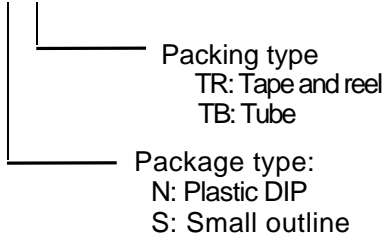
Example: SS6660CSTR

in SO-8 package shipped on tape and reel.

Please note that CN is only available in tubes.

PIN CONFIGURATION

DIP-8
SO-8
TOP VIEW

BOOST	1	8 VIN
CAP+	2	7 OSC
GND	3	6 LV
CAP-	4	5 VOUT

ABSOLUTE MAXIMUM RATINGS

Supply Voltage (VIN to GND, or GND to VOUT) ....……….. 6.0V

Input Voltage on Pin 1, 6 and 7 ...…………........................……………….............. $-0.3V \sim V_{IN} + 0.3V$

Operating Temperature Range ....………..…….......... $-40°C \sim +85°C$

Storage Temperature Range.......………….............................……………….................... $-65°C \sim 150°C$

TEST CIRCUIT
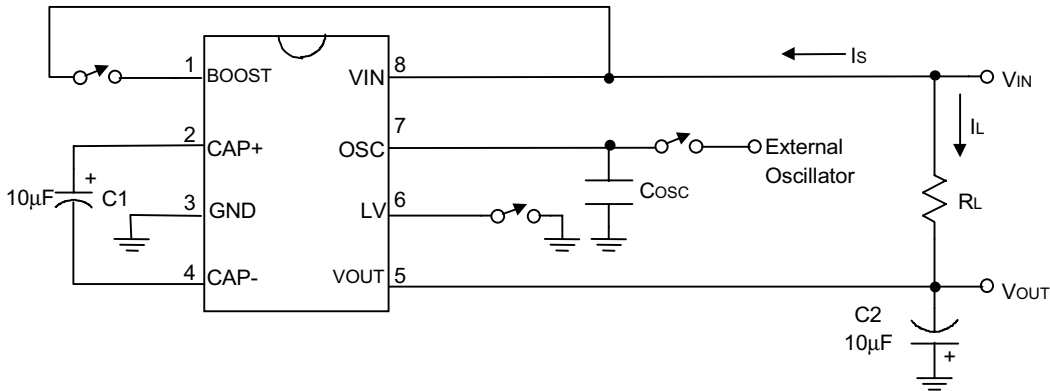
ELECTRICAL CHARACTERISTICS (V$_{IN}$ = 5.0V, TA = 25°C, OSC = OPEN, unless otherwise specified.)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN	TYP	MAX	UNIT
Supply Current	R$_L$ = ∞	I$_S$		36	70	μA
Minimum Supply Voltage	R$_L$ = ∞	V$_{INL}$	1.5			V
Maximum Supply Voltage	R$_L$ = ∞	V$_{INH}$			6	V
Output Resistance	I$_L$ =20mA, F$_{OSC}$ = 10kHz	R$_{OUT}$		35	70	Ω
Oscillator Frequency	C$_{OSC}$=0 Pin 1 Floating or GND Pin 1=V$_{IN}$	F$_{OSC}$		10 50		KHz
Power Efficiency	R$_L$= 5K, F$_{OSC}$=10kHz	η	96	98		%
Voltage Conversion Efficiency	R$_L$ = ∞	V$_{OUTEFF}$	98	99.9		%

TYPICAL PERFORMANCE CHARACTERISTICS (TA = 25°C)
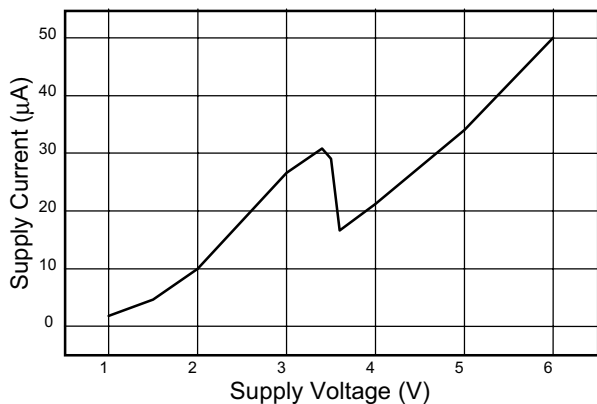
Fig. 1   Supply Current vs. Supply Voltage
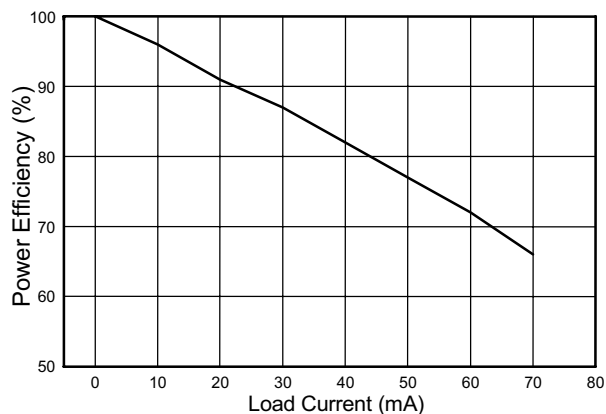
Fig. 2   Power Efficiency vs. Load Current

TYPICAL PERFORMANCE CHARACTERISTICS (cont.)
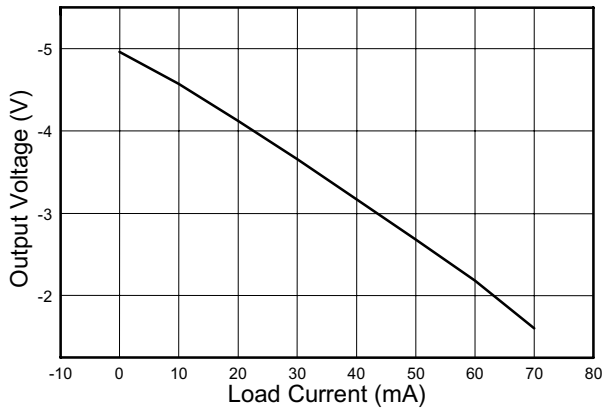
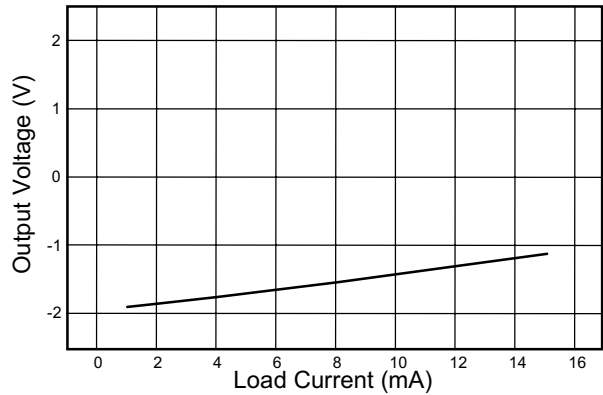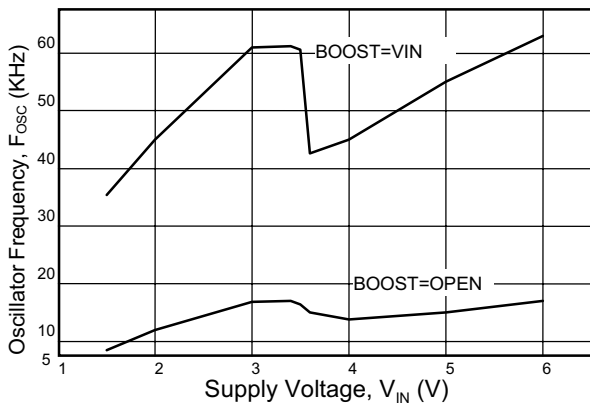Fig. 3   Output Voltage vs. Load Current

Fig. 4 Output Voltage vs. Load Current (V_{IN}=2V)
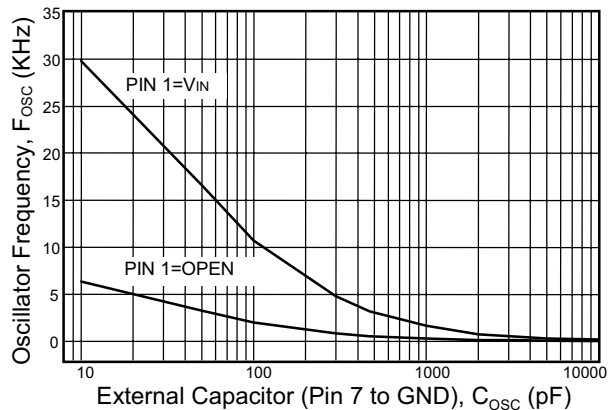

Fig. 5   Oscillator Frequency vs. Supply Voltage
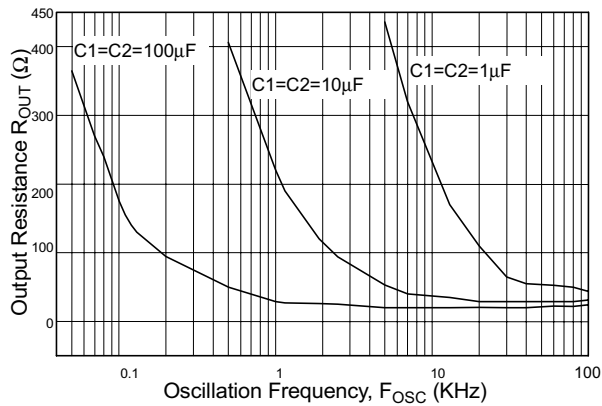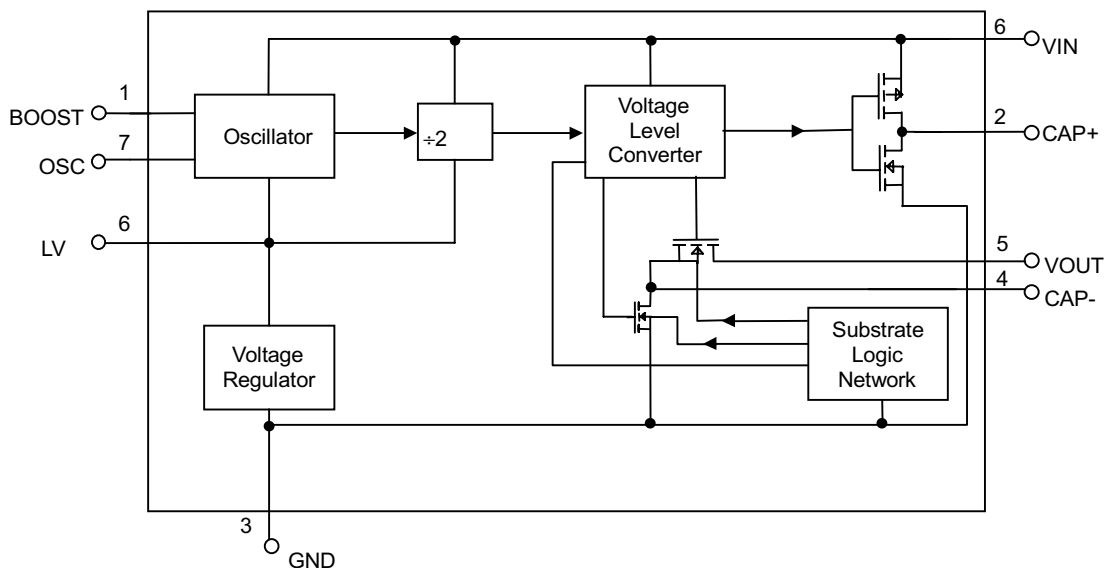

Fig. 6   Oscillator Frequency vs. Value of C_{OSC}

Fig. 7   Output Resistance vs. Oscillation Frequency

BLOCK DIAGRAM

PIN DESCRIPTIONS

PIN 1: BOOST - The frequency of oscillator will be 5 times if boost pin is connected to V_{IN}.

PIN 2: CAP+ - To be connected to the positive side of the flying capacitor.

PIN 3: GND - Ground

PIN 4: CAP- - To be connected to the negative side of flying capacitor.

PIN 5: VOUT - Negative output voltage, typically connected to a 10μF capacitor.

PIN 6: LV - If V_{IN} is below 3V, LV should be tied to GND. For V_{IN} larger than 3V, LV can be floating.

PIN 7: OSC - The frequency of oscillator can be lowered by the addition of an external capacitor to the OSC pin. Or the oscillator may be over-driven by an external clock.
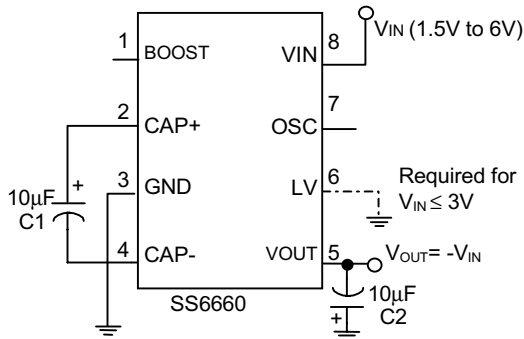
PIN 8: VIN - Input supply.

APPLICATION EXAMPLES

Fig. 8   Negative Voltage Converter

Fig. 8 shows a typical connection, which will provide a negative supply from an available positive supply without the need of any external diodes. The LV pin should be connect to ground for $V_{IN} \le 3V$, or may be "floated" for $V_{IN} > 3V$.
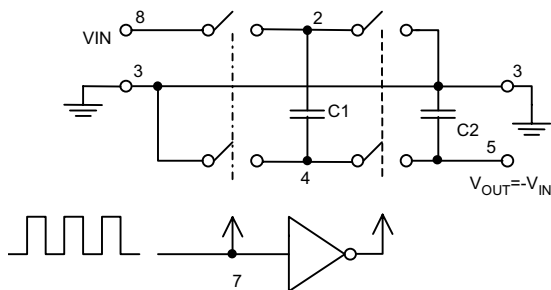

Fig. 9   Idealized Negative Voltage Converter
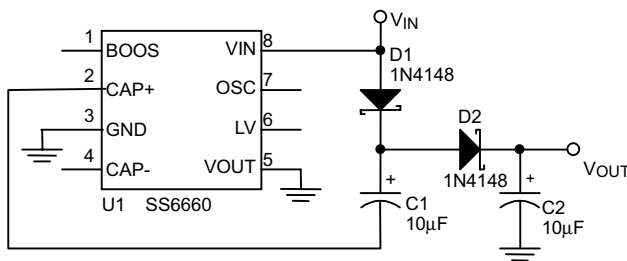
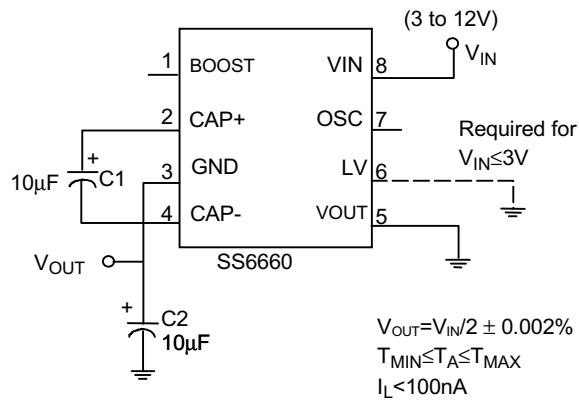Fig. 9 shows the idealized negative voltage converter.

Fig. 10   Voltage Doubling

Fig. 10 shows a method of voltage doubling. $V_{OUT} = 2V_{IN} - 2V_D$. To reduce the voltage drops across diodes, use Schottky diodes.

APPLICATION EXAMPLES (cont.)

An ultra precision voltage divider is shown in Fig. 11. To achieve the 0.002% accuracy as indicated, the load current should be kept below 100nA. However, with a slight loss in accuracy, the load current can be increased.

$V_{OUT} = V_{IN}/2 \pm 0.002\%$
$T_{MIN} \leq T_A \leq T_{MAX}$
$I_L < 100nA$

Fig. 11   Ultra Precision Voltage Divider
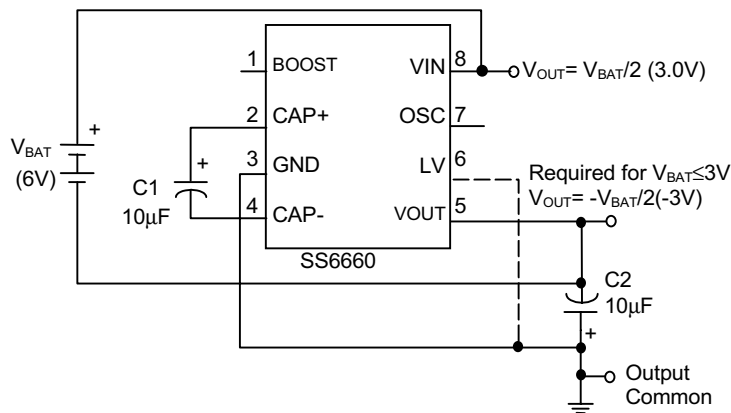
A common need in many systems is to obtain (+) and (-) supplies from a single battery or power supply system. Where current requirements are low, the circuit shown in Fig. 12 is a simple solution.

Fig. 12   Battery Splitter

PHYSICAL DIMENSIONS

8 Lead plastic SO (units: mm)
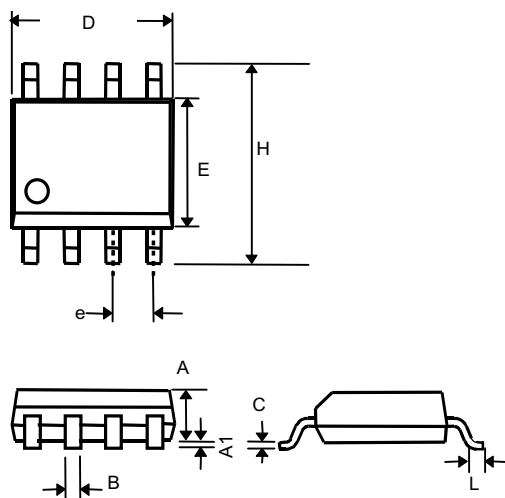
SYMBOL	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27(TYP)	
H	5.80	6.20
L	0.40	1.27

8 Lead plastic DIP (units: mm)
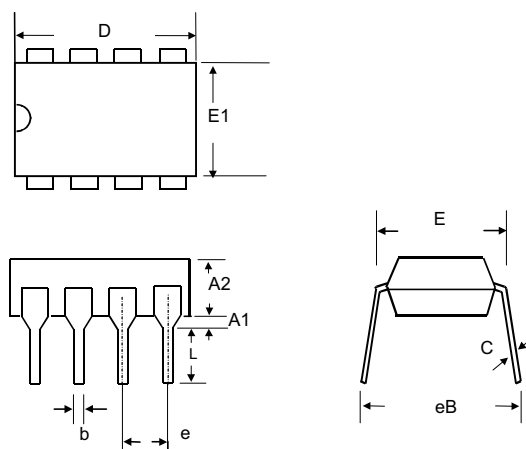
SYMBOL	MIN	MAX
A1	0.381	—
A2	2.92	4.96
b	0.35	0.56
C	0.20	0.36
D	9.01	10.16
E	7.62	8.26
E1	6.09	7.12
e	2.54 (TYP)	
eB	—	10.92
L	2.92	3.81