SCI7661C/M Series

CMOS DC/DC CONVERTER

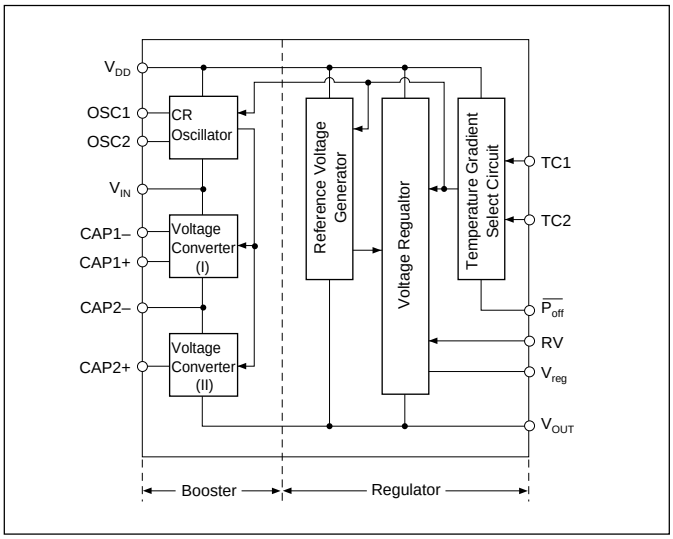
■ DESCRIPTION

The SCI7661C/M CMOS DC/DC Converter features high operational performance with low power dissipation. It consists of two major parts: the booster circuitry and the regulator circuitry. The booster generates a doubled output voltage (–2.4V to –12V) or tripled output voltage (–3.6V to –18V) from the input (–1.2V to –6V). The regulator is capable of setting the output to any desired voltage. The regulated voltage can be given one of three threshold temperature gradients.

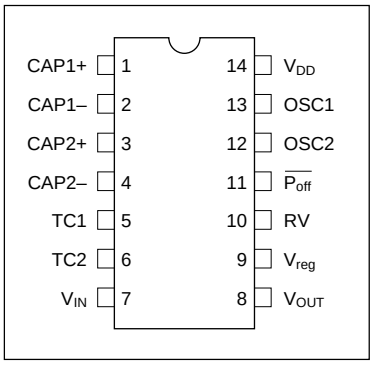
■ FEATURES

- High performance with low power dissipation
- Simple conversion of V_{IN} (–5V) to $|V_{IN}|$ (+5V), 2 $|V_{IN}|$ (+10V), 2 V_{IN} (–10V) or 3 V_{IN} (–15V)
- On–chip output voltage regulator
- Power conversion efficiency ..... Typ 95%
- Temperature gradient for LCD power supply ..... 0.1%/°C, 0.4%/°C or 0.6%/°C
- Power off by external signals — Stationary current at power off ... Max 2μA
- Cascade connection — two devices connected ..... V_{IN}=–5V, V_{OUT}=–20V
- On–chip C–R oscillator
- Package ..... SCI7661C$_{OA\ ..}$ DIP–14pin (plastic)
  SCI7661M$_{OA\ ..}$ SOP5–14pin (plastic)

■ BLOCK DIAGRAM



■ PIN CONFIGURATION



The same pin configuration in DIP and SOP

■ PIN DESCRIPTION

Pin Name	Pin No.	Function
CAP1+, CAP1–	1, 2	Terminal for connection of capacitor for doubler
CAP2+, CAP2–	3, 4	Terminal for connection of capacitor for tripler
TC1, TC2	5, 6	Temperature gradient selection terminal
V_{IN}	7	Power supply terminal (negative, system supply GND)
V_{OUT}	8	Output terminal at tripling
V_{reg}	9	Regulated voltage output terminal
RV	10	Regulated voltage control terminal
$\overline{P_{off}}$	11	V_{reg} output ON/OFF control terminal
OSC2, OSC1	12, 13	Oscillation resistor connection terminal
V_{DD}	14	Power supply terminal (positive system supply V_{CC})

■ ABSOLUTE MAXIMUM RATINGS

(V_{DD}=0V)

Parameter	Symbol	Ratings		Unit
Input supply voltage	V_I	–20/N*1 to 0.5		V
Input terminal voltage	V_I	V_{IN}–0.5 to 0.5	*2	V
		V_{OUT}–0.5 to 0.5	*3	V
Output voltage	V_O	min. –20.0		V
Allowable loss	P_d	300		mW
Operating temperature	T_{opr}	–30 to 85	*4	°C
Storage temperature	T_{stg}	–55 to 150		°C
Soldering temperature and time	T_{sol}	260°C, 10s (at lead)		—

***1** N=2: Doubler; N=3: Tripler ***2** OSC1, $\overline{P_{off}}$ ***3** TC1, TC2, RV ***4** Plastic package

Additional Note: When this IC is soldered in the solder–reflow process, be sure to maintain the reflow furnace temperature at the curve shown in “Figure 3–5 Reflow Furnace Temperature Curve” of DATA BOOK. And this IC cannot be exposed to high temperature of the solder dipping.

■ ELECTRICAL CHARACTERISTICS

(V_{DD}=0V, V_{IN}=–5V, T_a=–30° to 85°C)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input supply voltage	V_I		–6.0		–1.2	V
Output voltage	V_O		–18.0			V
	V_{reg}	R_L=∞, R_{RV}=1MΩ, V_O=–18V	–18.0		–2.6	V
Regulator operating voltage	V_{OUT}		–18.0		–3.2	V
Booster current consumption	I_{opr1}	R_L=∞, R_{OSC}=1MΩ		60	100	μA
Regulator current consumption	I_{opr2}	R_L=∞, R_{RV}=1MΩ, V_O=–15V		5.0	12.0	μA
Stationary current	I_Q	TC2=TC1=V_{OUT}, R_L=∞			2.0	μA
Oscillation frequency	f_{OSC}	R_{OSC}=1MΩ	16	20	24	kHz
Output impedance	R_{OUT}	I_{OUT}=10mA		150	200	Ω
Booster power conversion efficiency	P_{eff}	I_{OUT}=5mA	90	95		%
Regulated output voltage fluctuation	$\frac{\Delta V_{reg}}{\Delta V_{OUT} \cdot V_{reg}}$	–18V<V_{OUT}<–8V, V_{reg}=–8V, R_L=∞, Ta=25°C		0.2		% / V
Regulated output load fluctuation	$\frac{\Delta V_{reg}}{\Delta I_{OUT}}$	V_{OUT}=–15V, V_{reg}=–8V, 0<I_{OUT}<10mA, T_a=25°C, TC1=V_{DD}, TC2=V_O		5		Ω
Regulated output saturation resistance	R_{SAT}	R_{SAT}=Δ(V_{reg}–V_{OUT})/ΔI_{OUT}, 0<I_{OUT}<10mA, R_V=V_{DD}, T_a=25°C		8		Ω
Reference voltage	V_{RV0}	TC2=V_{OUT}, TC1=V_{DD}, T_a=25°C	–2.3	–1.5	–1.0	V
	V_{RV1}	TC2=TC1=V_{OUT}, T_a=25°C	–1.7	–1.3	–1.1	V
	V_{RV2}	TC2=V_{DD}, TC1=V_{OUT}, T_a=25°C	–1.1	–0.9	–0.8	V
Temperature Gradient	C_{T0}	$CT=\frac{\lvert V_{reg}(50°C)\rvert - \lvert V_{reg}(0°C)\rvert}{50°C - 0°C} \times \frac{1}{\lvert V_{reg}(25°C)\rvert} \times 100$	–0.25	–0.1	–0.06	% / °C
	C_{T1}		–0.5	–0.4	–0.3	% / °C
	C_{T2}		–0.7	–0.6	–0.5	% / °C
Input leakage current	I_L	$\overline{P_{off}}$, TC1, TC2, OSC1, RV pins			2.0	μA

■ RECOMMENDED OPERATING CONDITIONS

(T_a=–30° ~ 85°C)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Booster start voltage	V_{STA1}	R_{OSC}=1MΩ, C_3 ≥ 10μF *2, C_L/C_3 ≤ 1/20, T_a=–20° to 85°C			–1.2	V
	V_{STA2}	R_{OSC}=1MΩ			–2.2	V
Booster stop voltage	V_{STP}	R_{OSC}=1MΩ	–1.2			V
Output load resistance	R_L		R_L min *3			Ω
Output load current	I_{OUT}				20	mA
Oscillation frequency	f_{OSC}		10		30	kHz
External resistance for oscillation	R_{OSC}		680		2000	kΩ
Capacitor for booster	C_1, C_2, C_3		3.3			μF
Regulated output adjustable resistance	R_{RV}		100		1000	kΩ

*1 V_{DD}=0V

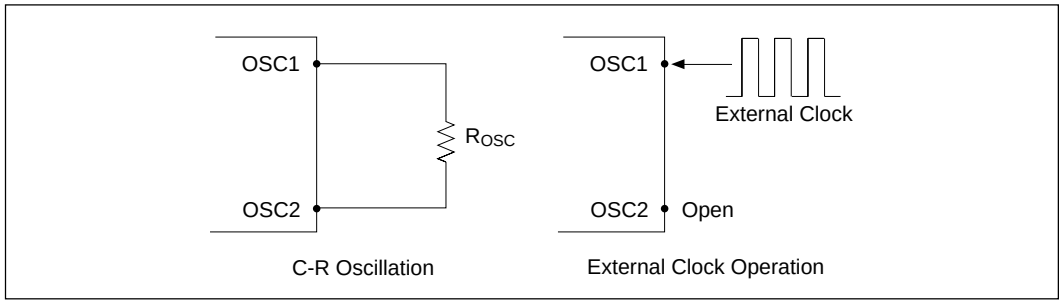
*2 Recommended circuitry in low voltage operation is shown below (next page, diagram on left) (V_{IN}=–1.2V~–2.2V)

*3 R_L min depends on input voltage as shown below (next page, diagram on right)

■ CIRCUIT DESCRIPTION

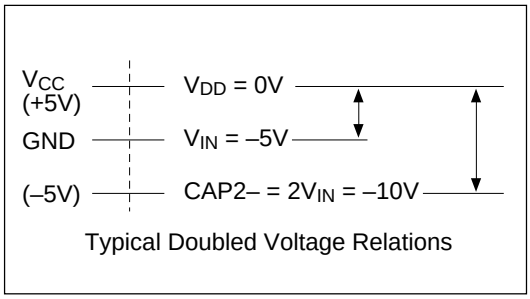
● C–R Oscillator

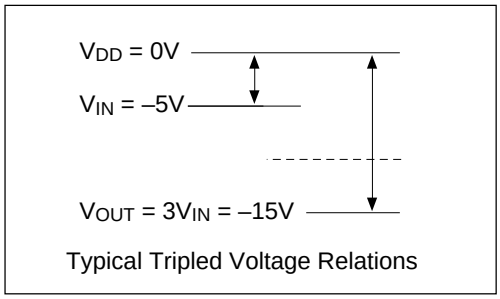
The SCI7661C/M contains a C–R oscillator for internal oscillation. It consists of an external resistor R_{OSC} connected between the OSC1 pin and OSC2 pin.



● Voltage Converters

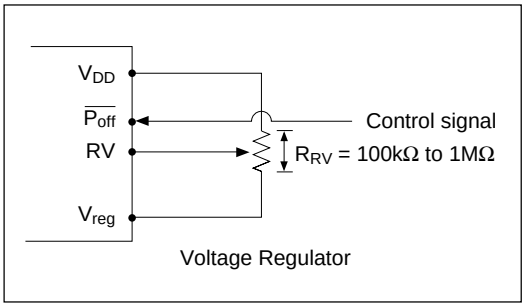
The voltage converters double/triple the input supply voltage (V_{IN}) using clocks generated by the C–R oscillator.





● Reference Voltage Generator and Voltage Regulator

The reference voltage generator produces reference voltage needed for operation of regular circuit. The voltage regulator is used to regulate a boosted output voltage and its circuit contains a power–off function which uses signals from the system for on–off control of the V_{reg} output.



● Temperature Gradient Selector Circuit

The SCI7661C/M provides the V_{reg} output with a temperature gradient suitable for LCD driving (between V_{DD} and V_{reg}).

- **Temperature Gradient Assignment**

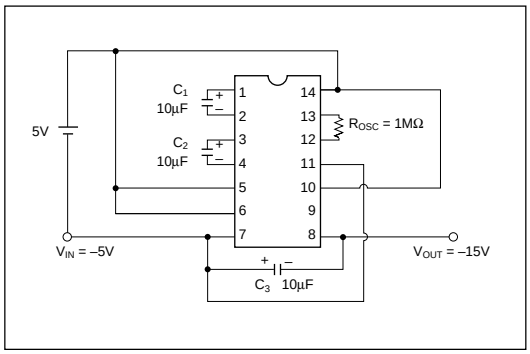
$\overline{P_{off}}$	TC2	TC1	Temp. Gradient	V_{reg} Output	CR oscillation	Remarks
1 (V_{DD})	L (V_{OUT})	L (V_{OUT})	–0.4% / °C	ON	ON	
1	L	H (V_{DD})	–0.1% / °C	ON	ON	
1	H (V_{DD})	L	–0.6% / °C	ON	ON	
1	H	H	–0.6% / °C	ON	OFF	Cascade connection
0 (V_{IN})	L	L	—	OFF (Hi-Z)	OFF	
0	L	H	—	OFF (Hi-Z)	OFF	
0	H	L	—	OFF (Hi-Z)	OFF	
0	H	H	—	OFF (Hi-Z)	ON	Without regulation

NOTE: The potential at Low level is different between the $\overline{P_{off}}$ pin and the TC1/TC2 pin.

■ EXAMPLE OF APPLICATIONS

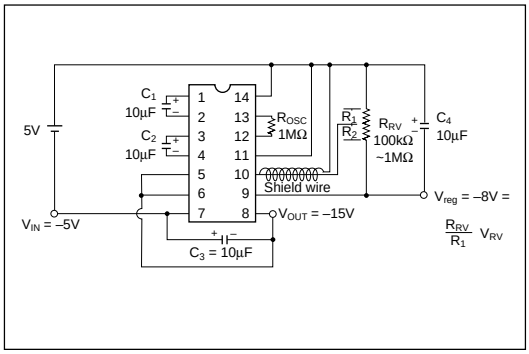
- **Voltage Doubler and Tripler**

  A doubled voltage can be obtained at V_{OUT} (CAP2–) by disconnecting capacitor C_2 from the tripler configuration and shorting CAP2– (pin 4) and V_{OUT} (pin 8).



- **Voltage Tripler + Regulator**

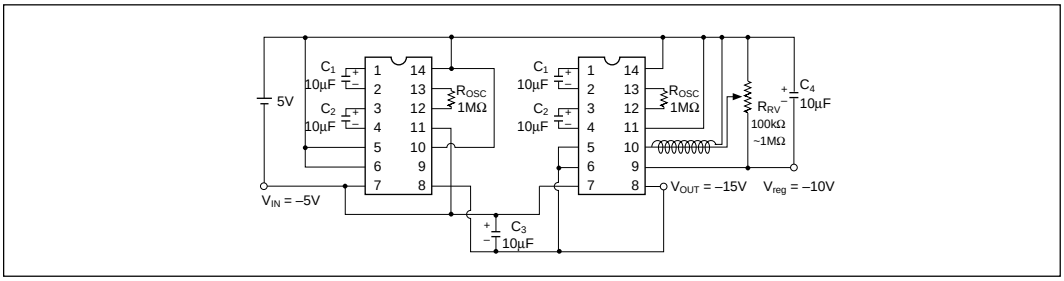
  V_{reg} output is given a temperature gradient, after boosted output V_{OUT} regulated. In this connection, both V_{OUT} and V_{reg} can be taken out at the same time.



- **Parallel Connection**

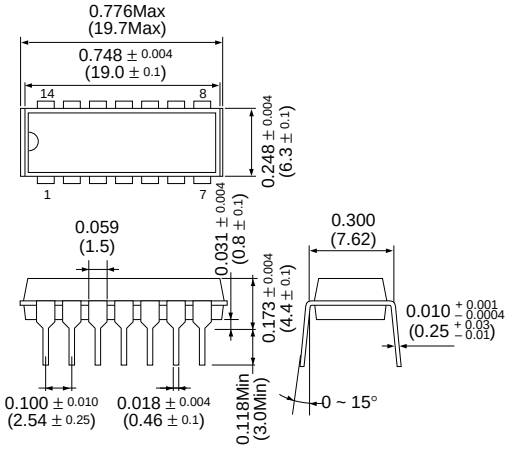
  Parallel connection of n circuits can reduce R_{OUT} to about 1/n, that output impedance R_{OUT} can be reduced by connecting serial configuration. A single smoothing capacitor C_3 can be used commonly for all parallelly connected circuits.

  In parallel connection, a regulated output can be obtained by applying the regulation circuit to only one of the n parallelly connected circuits.



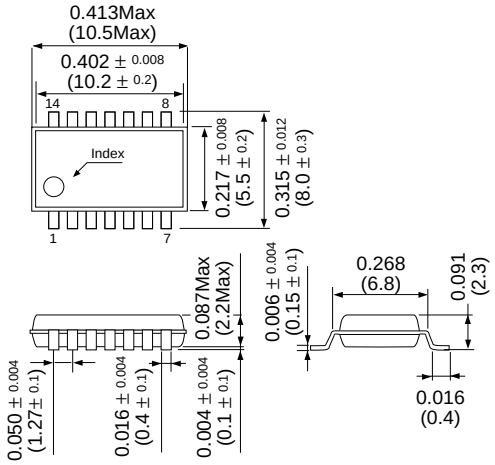
■ PACKAGE DIMENSIONS

Plastic DIP-14 pin



unit : inch (mm)

Plastic SOP5-14 pin



unit : inch (mm)