

SCI7661C_{0B}/M_{0B}

DC-DC Converter



- 95% Typical Power Efficiency
- Doubled or Tripled Output Voltage
- Internal Voltage Regulator

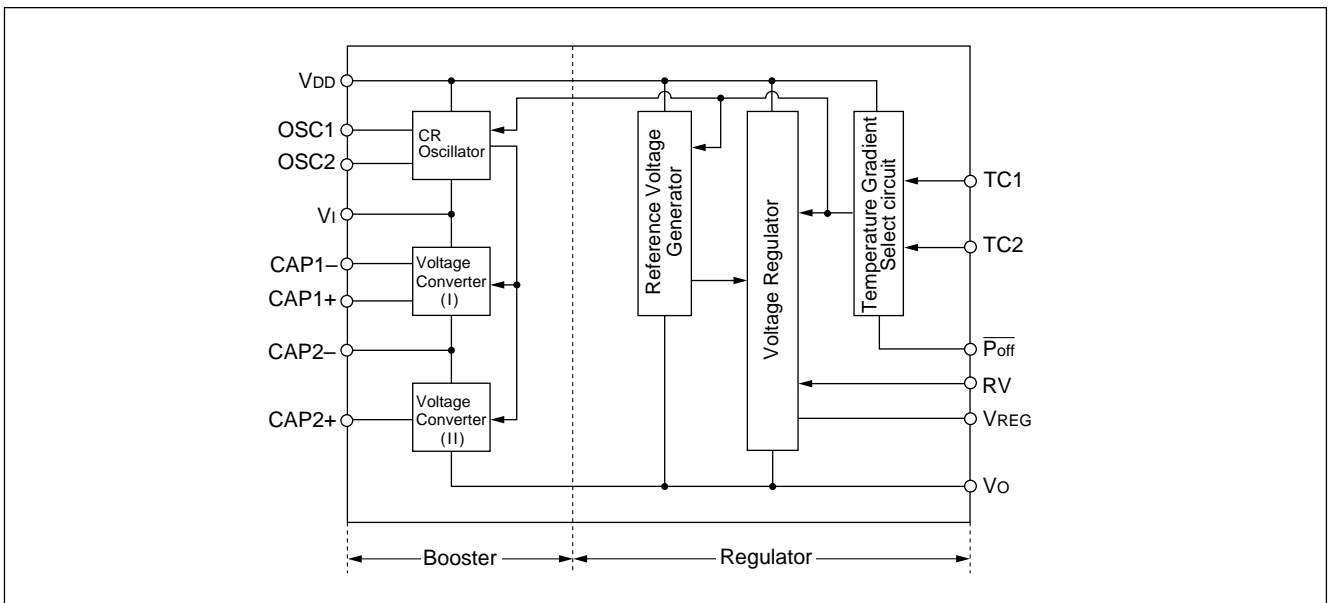
DESCRIPTION

The SCI7661C_{0B}/M_{0B} 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 (-3.6V to -12V) or tripled output voltage (-5.4V to -18V) from the input (-1.8 to -6V). The regulator is capable of setting the output to any desired voltage. The regulated voltage can be given one of the three threshold temperature gradients.

FEATURES

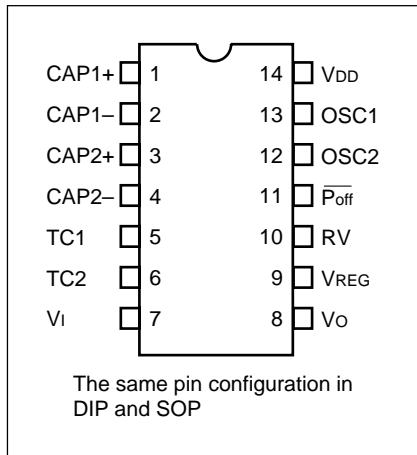
- High performance with low power dissipation
- Simple conversion of V_I (-5V) to $|V_I|$ (+5V), $2|V_I|$ (+10V), $2V_I$ (-10V) or $3V_I$ (-15V)
- On-chip output voltage regulator
- Power conversion efficiency – Typ.95%
- Temperature gradient for LCD power supply – 0.1%/°C, -0.4%/°C or -0.6%/°C
- Power off by external signals – Stationary current at power off – Max. 2μA
- Cascade connection – two device connected: $V_I = -5V$, $V_O = -20V$)
- On-chip C-R oscillator
- Package SCI7661C_{0B}: DIP-14pin (plastic)
 SCI7661M_{0B}: SOP5-14pin (plastic)
 SCI7661M_{BB}: SSOP2-16pin (plastic)

BLOCK DIAGRAM



SCI7661C_{0B}/M_{0B}

■ PIN CONFIGURATION



■ PIN DESCRIPTION

Pin name	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
VI	7	Power supply terminal (negative, system supply GND)
VO	8	Output terminal at tripling
VREG	9	Regulated voltage output terminal
RV	10	Regulated voltage control terminal
Poff	11	Vreg output ON/OFF control terminal
OSC2, OSC1	12, 13	Oscillation resistor connection terminal
VDD	14	Power supply terminal (positive system supply Vcc)

■ ABSOLUTE MAXIMAM RATINGS

(V_{DD} = 0V)

Rating	Symbol	Min.	Max.	Unit	Remark
Input supply voltage	VI	-20/N	V _{DD} +0.3	V	N = 2 : Doubler N = 3 : Tripler
Input terminal voltage	VI	VI-0.5	V _{DD} +0.3	V	OSC1, Poff
		VO-0.5	V _{DD} +0.3	V	TC1, TC2, RV
Output voltage	VO	-20.0		V	
Allowable loss	Pd		300	mW	
Operating temperature	T _{opr}	-40	85	°C	Plastic package
Storage temperature	T _{stg}	-55	150	°C	
Soldering temperature and time	T _{sol}	260°C, 10s (at lead)		-	

Note: When this IC is soldered in the solder-reflow process, be sure to maintain the reflow furnace at the curve shown in "Fig. 3-5 Temperature Profile for Standard SMD Package (QFP, SOP, PLCC and etc.) of this DATA BOOK. And this IC can not be exposed to high temperature of the solder dipping.

■ ELECTRICAL CHARACTERISTICS

(V_{DD} = 0V, VI = -5V, Ta = -40 to 85°C)

Characteristic	Symbol	Min.	Typ.	Max.	Unit	Condition
Input supply voltage	VI	-6.0		-1.8	V	
Output voltage	VO	-18.0			V	
	VREG	-18.0		-2.6	V	RL = ∞, RRV = 1MΩ VO = -18V
Regulator operating voltage	VO	-18.0		-3.2	V	
Booster current consumption	Iopr1		40	80	μA	RL = ∞, ROSC = 1MΩ
Regulator current consumption	Iopr2		5.0	12.0	μA	RL = ∞, RRV = 1MΩ VO = -15V
Stationary current	Iq			2.0	μA	TC2 = TC1 = VO, RL = ∞
Oscillation frequency	fOSC	16	20	24	kHz	ROSC = 1MΩ
Output impedamce	ROUT		150	200	Ω	IO = 10mA
Booster power conversion efficiency	Peff	90	95		%	IO = 5mA
Regulated output voltage fluctuation	$\frac{\Delta V_{REG}}{\Delta V_O \cdot V_{REG}}$		0.2		%/V	-18V < VO < -8V VREG = -8V, RL = ∞, Ta = 25°C

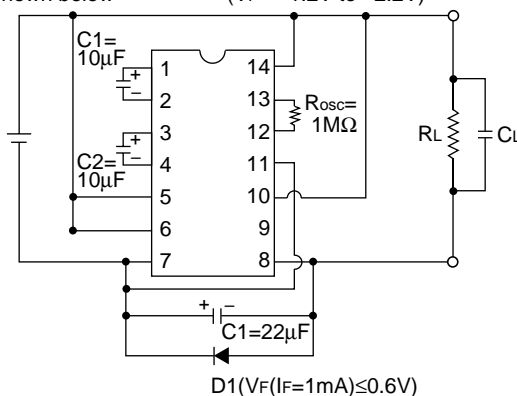
Characteristic	Symbol	Min.	Typ.	Max.	Unit	Condition
Regulated output load fluctuation	$\frac{\Delta V_{REG}}{\Delta I_O}$		5.0		Ω	$V_O = -15V, V_{REG} = -8V,$ $T_a = 25^\circ C$ $0 < I_O < 10mA, TC1 = V_{DD}$ $TC2 = V_O$
Regulated output saturation resistance	RSAT		8.0		Ω	$RSAT = \Delta(V_{REG} - V_O) / \Delta I_O$ $0 < I_O < 10mA, RV = V_{DD},$ $T_a = 25^\circ C$
Reference voltage	VRV0	-2.3	-1.5	-1.0	V	$TC2 = V_O, TC1 = V_{DD}, T_a = 25^\circ C$ $TC2 = TC1 = V_O, T_a = 25^\circ C$ $TC2 = V_{DD}, TC1 = V_O, T_a = 25^\circ C$
	VRV1	-1.7	-1.3	-1.1		
	VRV2	-1.1	-0.9	-0.8		
Temperature Gradient	CT0	-0.25	-0.1	-0.01	%/°C	$CT = \frac{ V_{REG}(50^\circ C) - V_{REG}(0^\circ C) }{50^\circ C - 0^\circ C}$ $\times \frac{1}{ V_{REG}(25^\circ C) } \times 100$
	CT1	-0.5	-0.4	-0.3		
	CT2	-0.7	-0.6	-0.5		
Input leakage current	IL			2.0	μA	Poff, TC1, TC2, OSC1, RV pins

RECOMMENDED OPERATING CONDITIONS

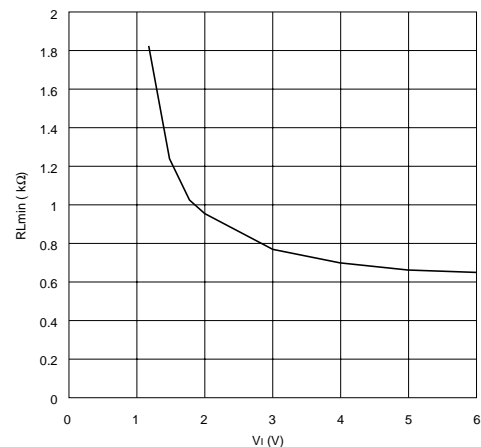
($T_a = -30$ to $85^\circ C$)

Condition	Symbol	Min.	Max.	Unit	Remark
Booster start voltage	VSTA		-1.8	V	$R_{OSC} = 1M\Omega, C_3 \geq 10\mu F^{*1}$ $CL/C_3 \leq 1/20, T_a = -20$ to $85^\circ C$
Booster stop voltage	VSTP	-1.8		V	$R_{OSC} = 1M\Omega$
Output load resistance	RL	RL Min.*2		Ω	
Output load current	IOUT		20	mA	
Oscillation frequency	fosc	10	30	kHz	
External resistance for oscillation	Rosc	680	2000	k Ω	
Capacitor for booster	C1,C2,C3	3.3		μF	
Regulated output adjustable resistance	RRV	100	1000	k Ω	

*1: Recommended circuitry in low voltage operation is shown below ($V_i = -1.2V$ to $-2.2V$)



RL Min. depends on input voltage as shown below.

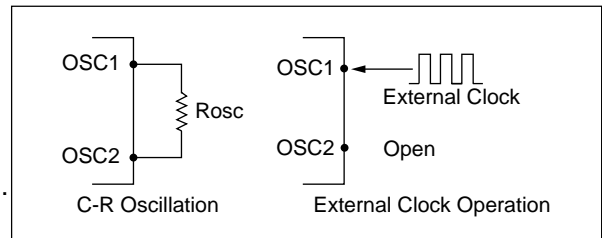


SCI7661C0B/M0B

■ CIRCUIT DESCRIPTION

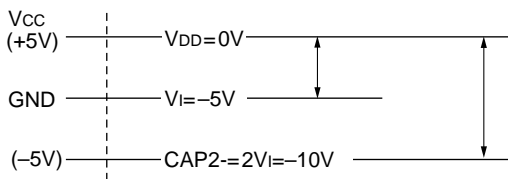
● C-R Oscillator

The SCI7661C0B/M0B contains a C-R oscillator for internal oscillation. It consists of an external resistor ROSC connected between the OSC1 pin and OSC2 pin.

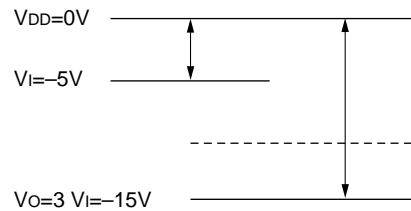


● Voltage Converters

The voltage converters double/triple the input supply voltage (Vi) using clocks generated by the C-R oscillator.



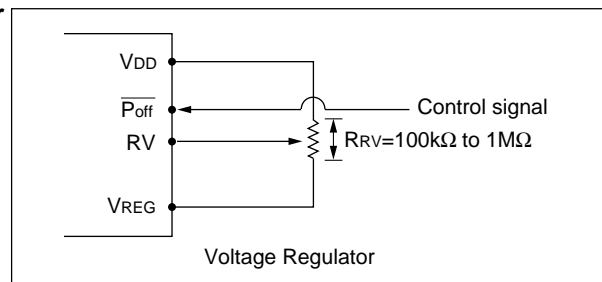
Typical Doubled Voltage Relations



Typical Tripled Voltage Relations

● Reference Voltage Generator and Voltage Regulator

The reference voltage generator produces reference voltage needed for operation of regulator 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 Vreg output.



● Temperature Gradient Selector Circuit

The SCI7661C0B/M0B provides the VREG output with a temperature gradient suitable for LCD driving.
(between VDD and VREG)

● Temperature Gradient Assignment

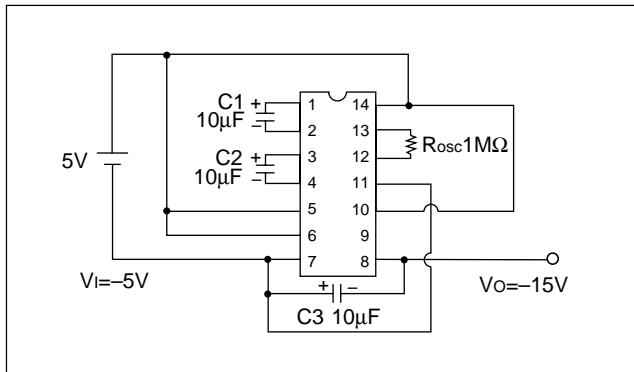
Poff	TC2	TC1	Temp. Gradient	VREG Output	CR oscillation	Remarks
1(VDD)	L(Vo)	L(Vo)	-0.4%/°C	ON	ON	Cascade connection
1	L	H(VDD)	-0.1%/°C	ON	ON	
1	H(VDD)	L	-0.6%/°C	ON	ON	
1	H	H	-0.6%/°C	ON	OFF	
0(Vi)	L	L	-	OFF (Hi-Z)	OFF	Without regulation
0	L	H	-	OFF (Hi-Z)	OFF	
0	H	L	-	OFF (Hi-Z)	OFF	
0	H	H	-	OFF (Hi-Z)	ON	

Note: The potential at Low level is different between the Poff pin and the TC1/TC2 pin.

■ BASIC EXTERNAL CONNECTION

● Voltage Doubler and Tripler

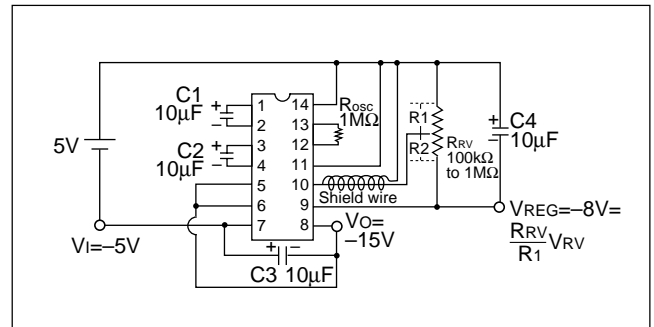
A doubled voltage can be obtained at V_O (CAP2-) by disconnecting capacitor C2 from the tripler configuration and shorting CAP2- (pin 4) and V_O (pin 8).



Voltage Tripler

● Voltage Tripler + Regulator

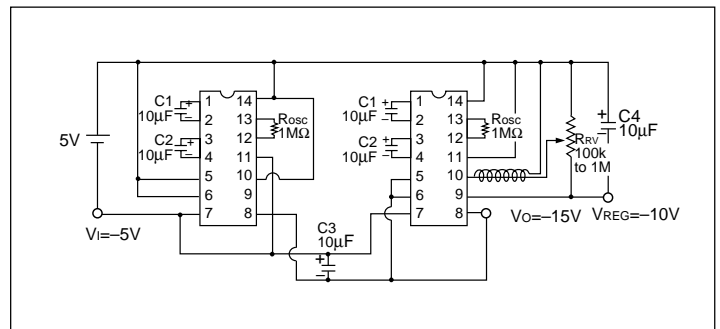
V_{REG} output is given a temperature gradient, after boosted output V_O regulated. In this connection, both V_O and V_{REG} can be taken out at the same time.



Tripler + Regulator
(-0.4%/°C selected as temperature gradient)

● Parallel Connection

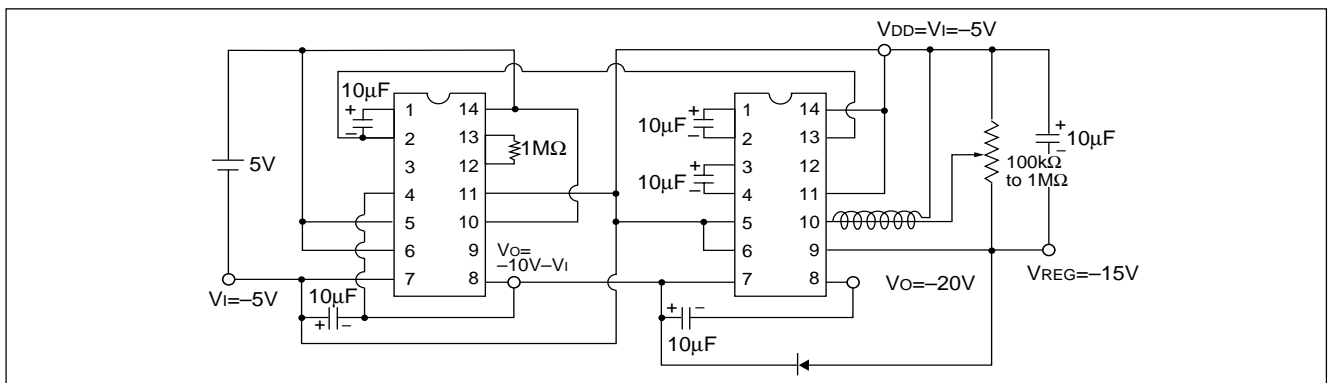
Parallel connections of n circuits can reduce R_{out} to about $1/n$, that output impedance R_{out} can be reduced by connecting serial configuration. A single smoothing capacitor C3 can be used commonly for all parallelly connected circuit. In parallelly connection, a regulated output can be obtained by applying the regulation circuit to only one of the n parallelly connected circuit.



Parallel Connection

● Cascade Connection

Cascade Connection of SCI7661C_{0B}/M_{0B} (by connecting V_{IN} and V_{OUT} of one stage to V_{DD} and V_I respectively of the next stage) further increase the output voltage. Note, however, that the serial connection increases the output impedance.

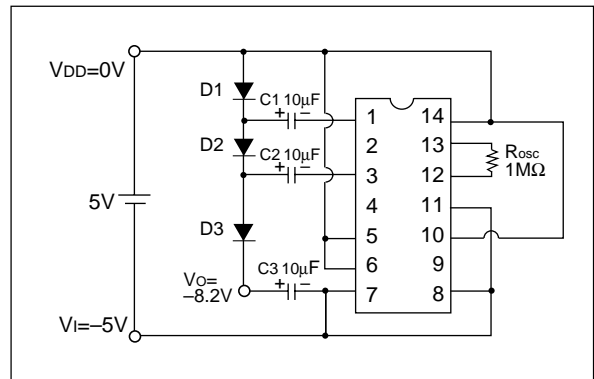


Serial Connection

SCI7661C0B/M0B

● Positive Voltage Conversion

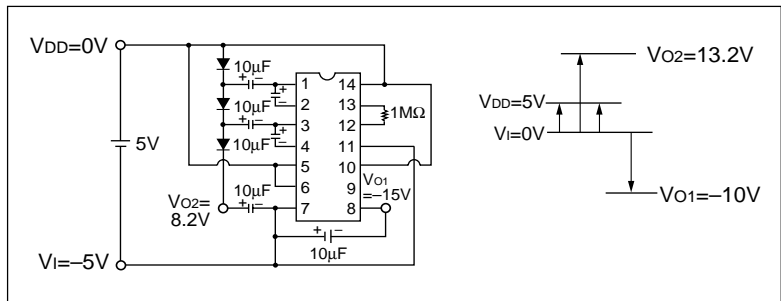
The input voltage can be doubled or tripled toward the positive side. (In the doubler configuration, capacitor C2 and diode D3 are disconnected and the diode D3 shorted at the both ends.) In this case, however, the output voltage decrease by V_F (forward voltage).
 For example $V_{DD} = 0V$, $V_I = -5V$ and $V_F = 6.0V$, then $V_O = 10V - 3 \times 0.6V = 8.2V$ (if doubled, $5V - 2 \times 0.6V = 3.8V$)



Positive Voltage Conversion D1, D2, D3: Shottky diodes with small V_F are recommended.

● Negative Voltage Conversion + Positive Voltage Conversion

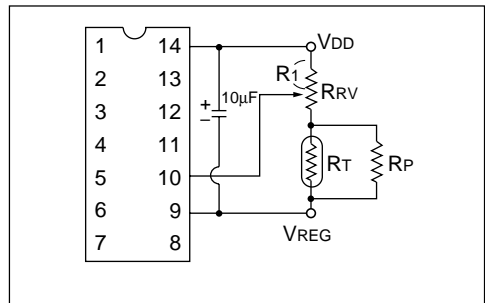
This circuit produces outputs of $-15V$ and $+8.2V$ from the $-5V$ input. Note that this configuration causes higher output impedance than in a single function (negative or positive voltage converter.)



Negative Voltage Conversion + Positive Voltage Conversion

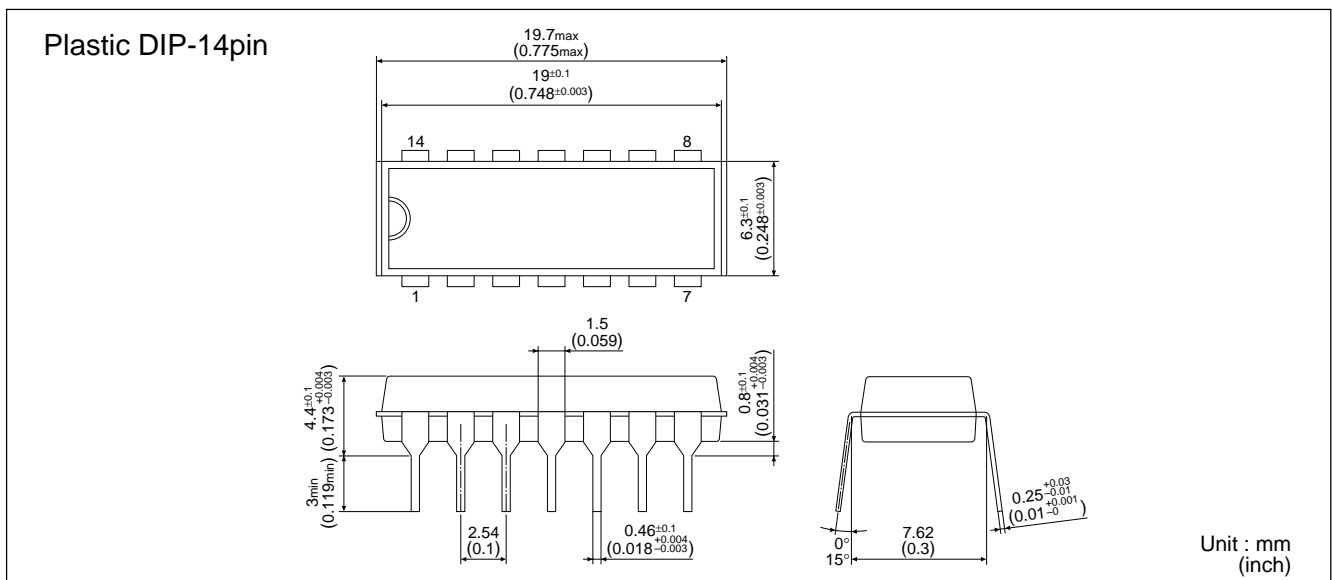
● Changing the Temperature Gradient through Use of External Temperature Sensor (Thermistor)

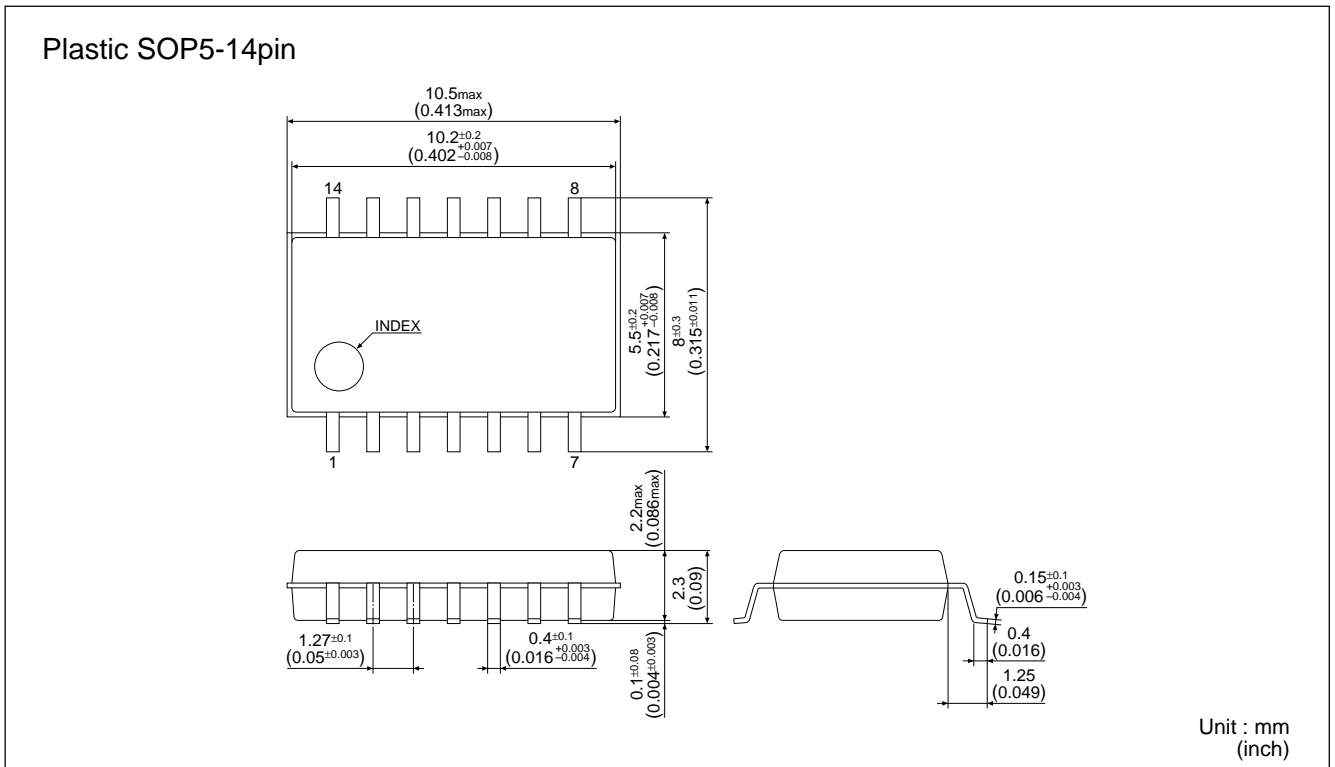
The SCI7661C0B/M0B has a temperature gradient selector circuit in its regulator. It selects any one of the three gradients: $-0.1\%/^{\circ}C$, $-0.4\%/^{\circ}C$ and $-0.6\%/^{\circ}C$. It is necessary that the temperature gradient can be changed to any other value by connecting a thermistor in series to the output voltage control resistor R_{RV} .



Example of Change of Temperature Gradient

■ PACKAGE DIMENSIONS





NOTICE:

No part of this material may be reproduced or duplicated in any form or by any means without the written permission of Seiko Epson. Seiko Epson reserves the right to make changes to this material without notice. Seiko Epson does not assume any liability of any kind arising out of any inaccuracies contained in this material or due to its application or use in any product or circuit and, further, there is no representation that this material is applicable to products requiring high level reliability, such as, medical products. Moreover, no license to any intellectual property rights is granted by implication or otherwise, and there is no representation or warranty that anything made in accordance with this material will be free from any patent or copyright infringement of a third party. This material or portions thereof may contain technology or the subject relating to strategic products under the control of the Foreign Exchange and Foreign Trade Law of Japan and may require an export license from the Ministry of International Trade and Industry or other approval from another government agency.

© Seiko Epson Corporation 2000 All right reserved.

All other product names mentioned herein are trademarks and/or registered trademarks of their respective companies.

SEIKO EPSON CORPORATION

ELECTRONIC DEVICES MARKETING DIVISION

IC Marketing & Engineering Group

ED International Marketing Department I (Europe, U.S.A)

421-8 Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: 042-587-5812 FAX: 042-587-5564

ED International Marketing Department II (ASIA)

421-8 Hino, Hino-shi, Tokyo 191-8501, JAPAN
Phone: 042-587-5814 FAX: 042-587-5110

■ Electronic devices information on the Epson WWW server.

<http://www.epson.co.jp/device/>

