GR7660 CMOS VOLTAGE CONVERTER

1. General Description

1.1 Description

The GR7660 is a CMOS switched-capacitor voltage converter that perform supply-voltage conversions from positive to negative. With only two noncritical external capacitors needed for the charge pump and charge reservoir functions, an input voltage within the range from 1.5 V to 10 V is converted to a complementary negative output voltage of −1.5V to −10V. The device can also be connected as a voltage doubler to generate output voltages up to 18.6 V with a 10-V input.

The basic building blocks of the IC include a linear regulator, an RC oscillator, a voltage-level translator, and four power MOS switches. To ensure latch-up-free operation, the circuitry automatically senses the most negative voltage in the device and ensures that the N-channel switch source-substrate junctions are not forward biased.

The oscillator frequency runs at a nominal 10 kHz (for VCC = 5 V), but that frequency can be decreased by adding an external capacitor to the oscillator (OSC) terminal or increased by overdriving OSC with an external clock.

For low-voltage operation (VIN < 3.5 V), LV should be tied to GND to bypass the internal series regulator. Above 3.5 V, LV should be left floating to prevent device latchup.

1.2 Features

- Simple Voltage Conversion, Including
  - – Negative Converter
  - – Voltage Doubler
- Wide Operating Range … 1.5 V to 10 V
- Requires Only Two External (Noncritical) Capacitors
- No External Diode Over Full Temperature and Voltage Range
- Typical Open-Circuit Voltage Conversion Efficiency … 99.9%
- Typical Power Efficiency … 96%
- Full Testing at 3 V

1.3 Device Information

PART NUMBER	PACKAGE
GR7660	DIP
	SOP

2. Pin Description and Functional Diagram

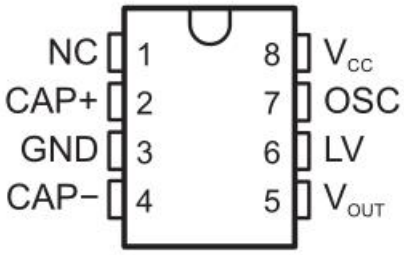


Figure 2.1 Top View

PIN No.	NAME	I/O	FUNCTION
1	NC		Not connect
2	CAP+	I	Data Input
3	GND		Ground
4	CAP-	I	Data Input
5	VOUT	O	Data Output
6	LV	I	Control Input
7	OSC	I	RC Oscillator
8	VCC		Supply Voltage

3. System Diagram

3.1 Function Diagram

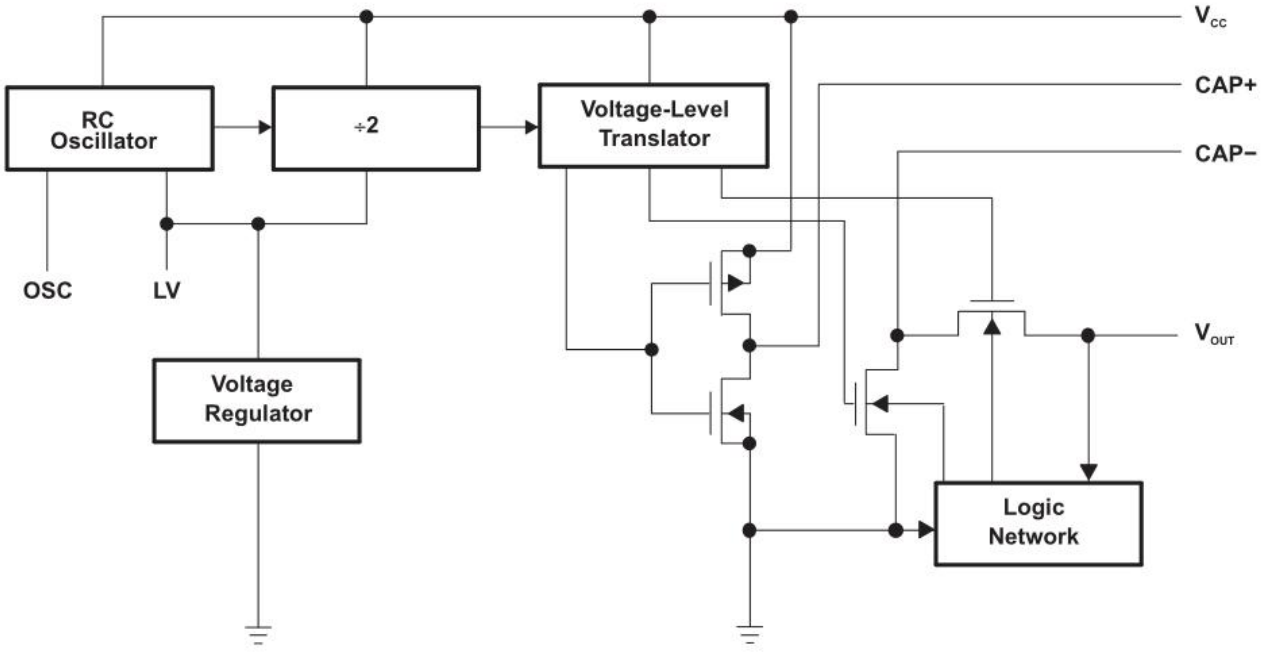


Figure 3.1 Functional Diagram

3.2 Test Circuit

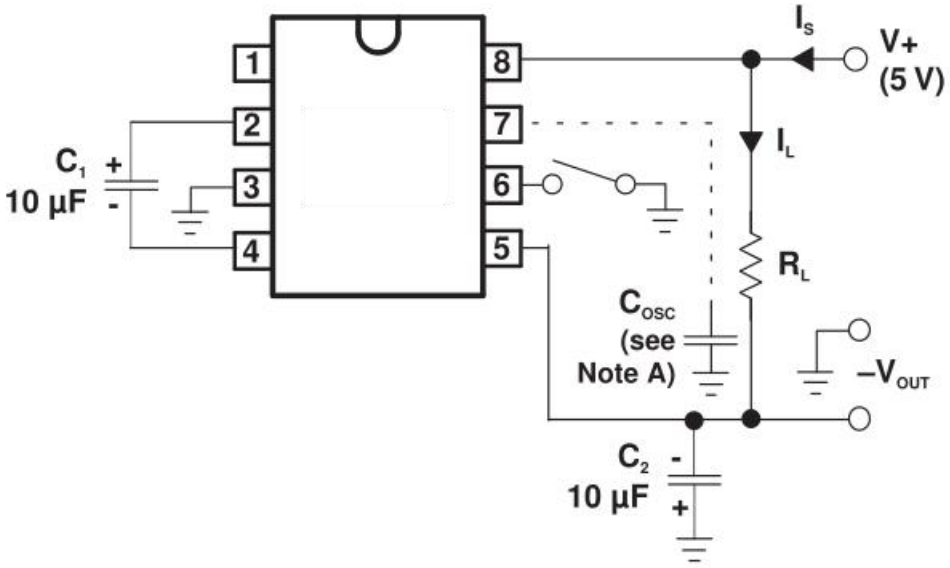


Figure 3.2：Test Circuit

NOTEA: In the circuit, there is no external capacitor applied to terminal 7. However when device is plugged into a test socket,there is usually a very small but finite stray capacitance present on the order of 10 pF.

3.3 Idealized Negative-Voltage Converter

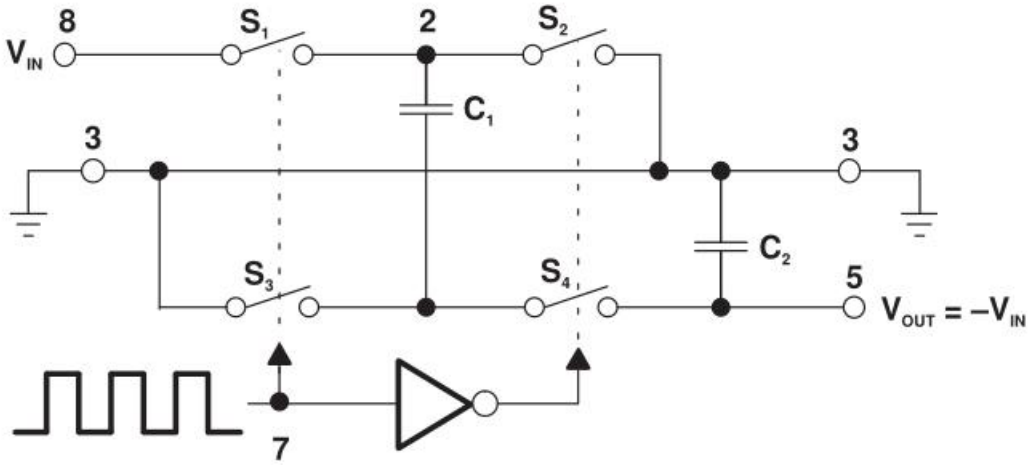


Figure 3.3：Idealized Negative-Voltage Converter

4. Specifications

4.1 Absolute Maximum Ratings

Symbol	Parameter		MIN	MAX	Unit
V_{CC}	DC Supply Voltage			10.5	V
V_I	OSC and LV input voltage range	VCC < 5.5 V	-0.3	VCC+0.3	V
		VCC > 5.5 V	VCC - 5.5	VCC+0.3	
T_J	Junction Temperature			150	℃
T_{OP}	Operating Temperature		-40	85	℃

Absolute maximum ratings are those values beyond which the device could be permanently damaged,These are stress ratings only,which do not imply functional operation of the device at these or any other conditions beyond those indicated under normal operating conditions.

4.2 Electrical Characteristics

(T_a=25℃,V_{SUPPLY}=5V, and C_{OSC} = 0, LV = Open, unless otherwise specified)(See Figure 3.2)

Symbol	Parameter	Test Condition	MIN	TYP	MAX	Unit
I_{DD}	Supply Current	RL = ∞	--	50	250	uA
$V_{CC,LOW}$	Supply voltage range (low)	RL = 10 kΩ, LV = GND	1.5	--	3.5	V
$V_{CC,HIGH}$	Supply voltage range (high)	RL = 10 kΩ, LV Open	3	--	10	V
R_{OUT}	Output source resistance	IO = 20 mA	--	90	--	Ω
		VCC = 2 V, IO = 1.5 mA, LV = GND	--	280	--	
f_{OSC}	Oscillator frequency		--	10		kHz
η_{POWER}	Power efficiency	RL = 5 kΩ	--	96	--	%
η_{VOUT}	Voltage conversion efficiency	RL = ∞	99	99.9	--	%

4.3 Electrical Characteristics

(T_a=25℃,VCC = 3 V,C_{OSC} = 0, LV = GND unless otherwise specified)(See Figure 3.2)

Symbol	Parameter	Test Condition	MIN	TYP	MAX	Unit
I_{DD}	Supply Current	RL = ∞	--	--	100	uA
R_{OUT}	Output source resistance	IO = 5 mA	--	140	--	Ω
f_{OSC}	Oscillator frequency	COSC = 0	5	8	--	kHz
η_{POWER}	Power efficiency	RL = 5 kΩ	--	94	--	%
η_{VOUT}	Voltage conversion efficiency	RL = ∞	99	--	--	%

5. Typical Performance Curves

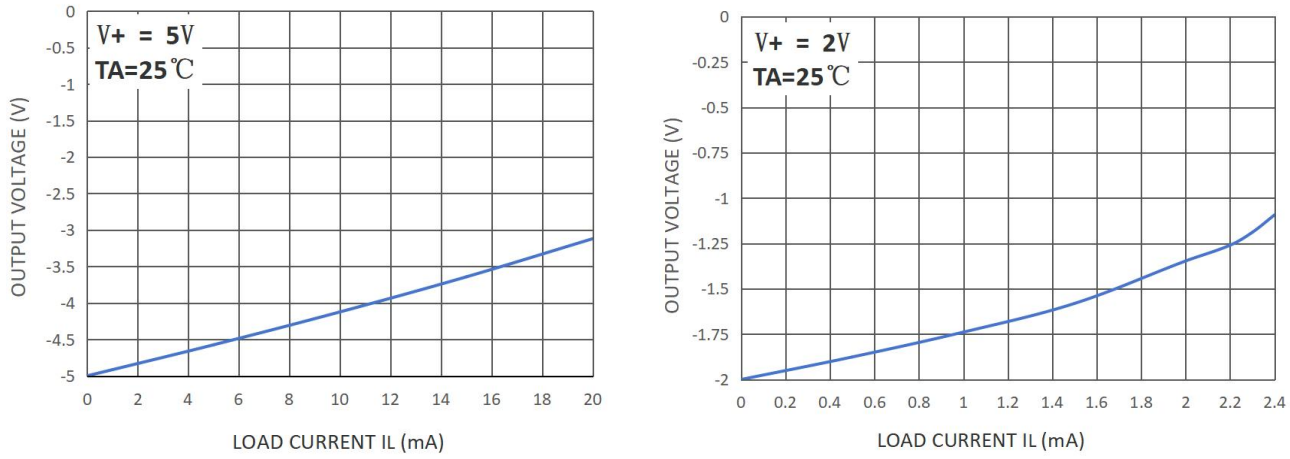


Figure 5.1. Output Voltage vs Output Current

6. Typical Application Circuit

6.1 Simple Negative Voltage Converter

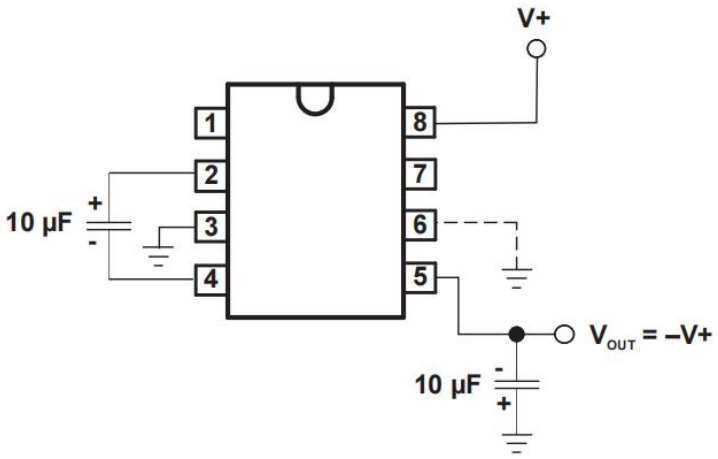


Figure 6.1. Simple Negative Voltage Converter

6.2 Paralleling Devices

$R_{OUT} = R_{OUT} /n$ (number of devices)

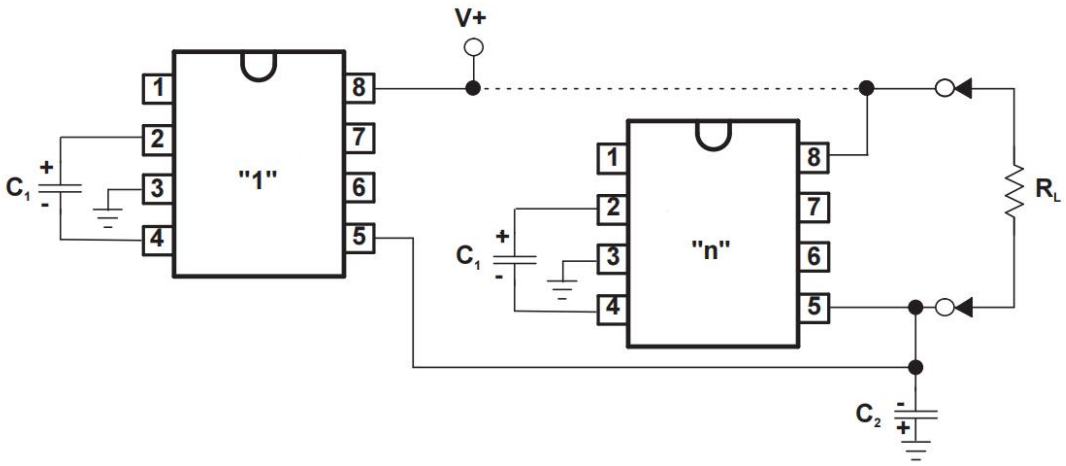


Figure 6.2. Paralleling Devices

6.3 Cascading Devices

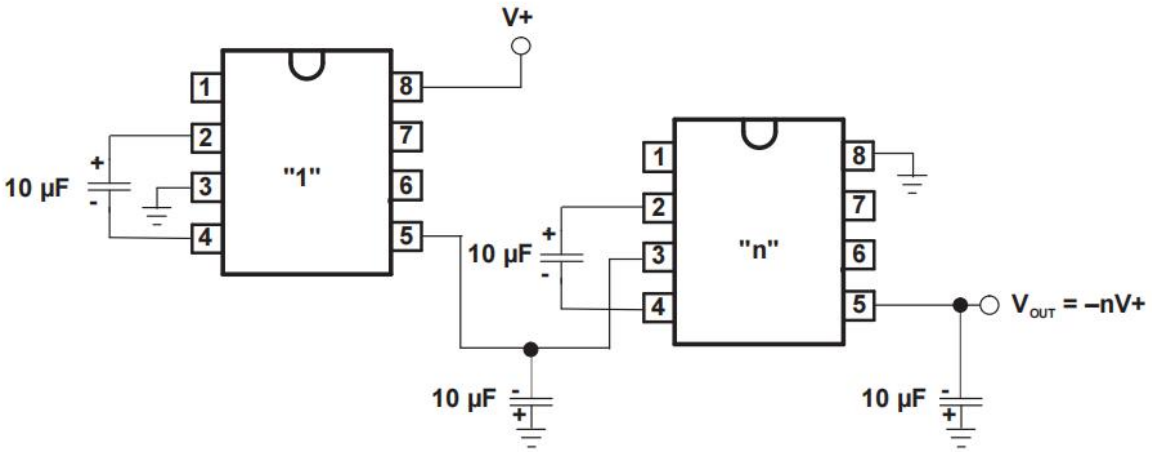


Figure 6.3. Cascading Devices for Increased Output Voltage

6.4 Positive Voltage Doubling

VF is the forward voltage drop of diode D1.

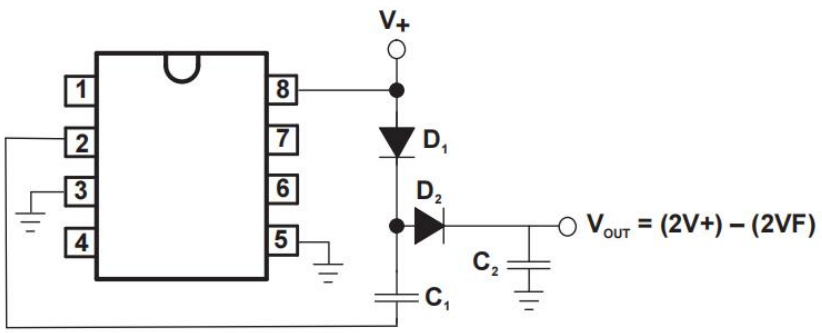


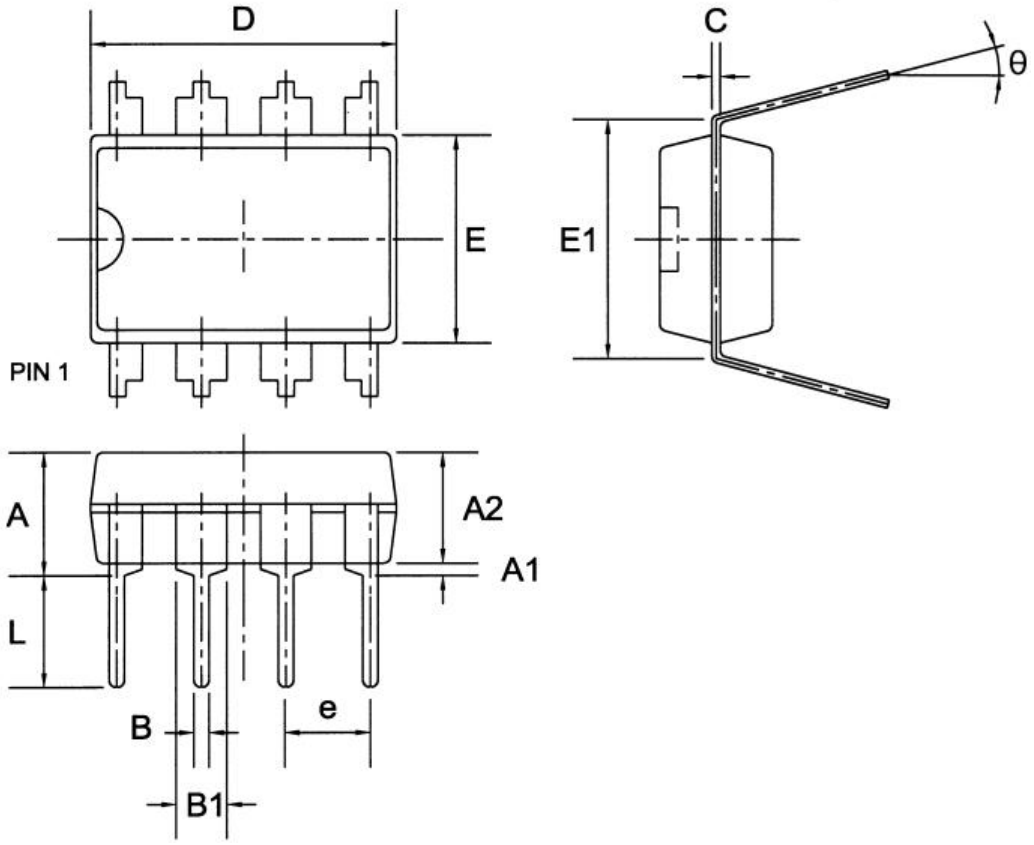
Figure 6.4. Positive-Voltage Doubler

7. Ordering Information

Orderable Device	Package Type	Pins	Packing	Package Qty
GR7660ND08ATEQ	DIP	8	Tape & Reel	50
GR7660NS08ARDQ	SOP	8	Tape & Reel	4000

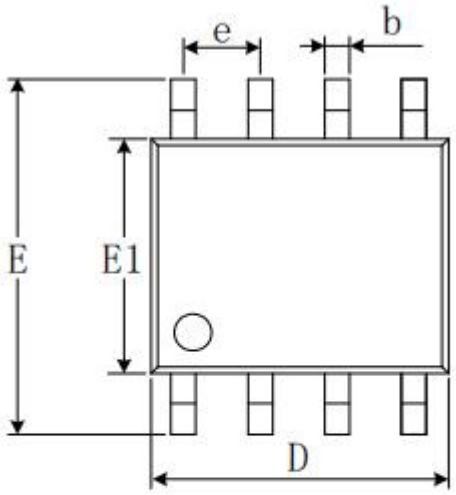
8. Package Information

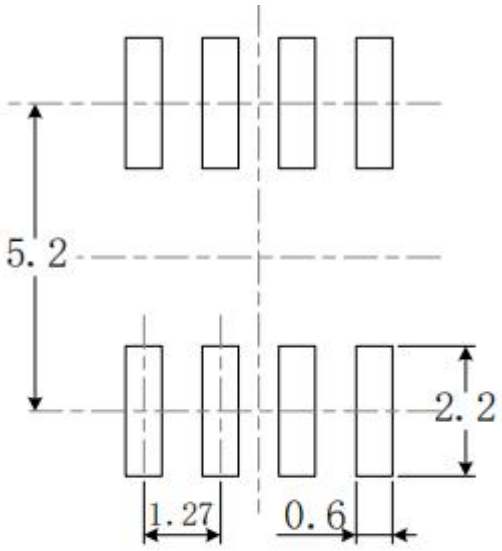
8.1 DIP8



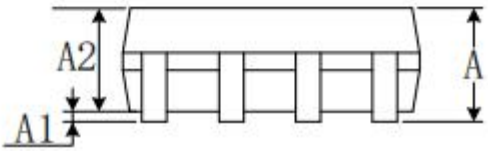
Symbol	Dimensions In Millmeters			Dimensions In Inches		
	Min	Nom	Max	Min	Nom	Max
A	—	—	4.31	—	—	0.170
A1	0.38	—	—	0.015	—	—
A2	3.15	3.40	3.65	0.124	0.134	0.144
B	0.38	0.46	0.51	0.015	0.018	0.020
B1	1.27	1.52	1.77	0.050	0.060	0.070
C	0.20	0.25	0.30	0.008	0.010	0.012
D	8.95	9.20	9.45	0.352	0.362	0.372
E	6.15	6.40	6.65	0.242	0.252	0.262
E1	—	7.62	—	—	0.300	—
e	—	2.54	—	—	0.100	—
L	3.00	3.30	3.60	0.118	0.130	0.142
θ	0°	—	15°	0°	—	15°

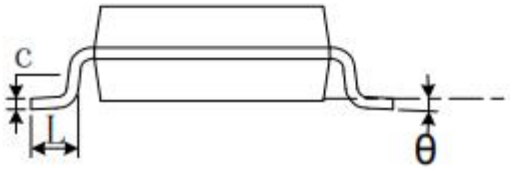
8.2 SOP8





RECOMMENDED LAND PATTERN (Unit: mm)





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	0.007	0.010
D	4.800	5.000	0.189	0.197
e	1.270(BSC)		0.050(BSC)	
E	5.800	6.200	0.228	0.244
E1	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°