8-bit Serial-In/Parallel-Out Constant-Current LED Driver

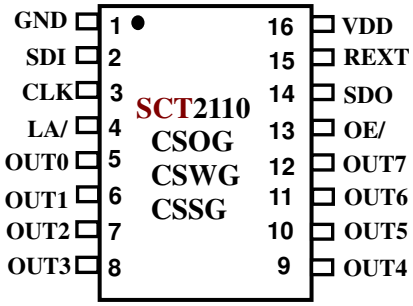
Product Description

The SCT2110 serial-interfaced LED driver sinks 8 LED clusters with constant current to keep the uniform intensity of LED displays. In applications, an external resistor is used to set the full-scale constant output current from 5mA up to 160mA. The SCT2110 guarantees each output can endure maximum 17V DC voltage stress. The built-in shift registers and data latches making the SCT2110 effective solution in driving LED display. The output enable function gates all 8 outputs on and off, and is fast enough to be used as PWM input for LED intensity control. Since the serial data input rate can be reached up to 25MHz, the SCT2110 will satisfy system which needs high volume data transmission to control the LED display.

Features

- 8 constant-current outputs rate at 17V
- Constant current range: 5 – 160mA
- Excellent current regulation to load, supply voltage and temperature
- ±3% Current matching between outputs
- ±6% Current matching between ICs
- Fast output current control: Minimum PWM pulse width = 100ns
- All output current are programmed together using a single external resistor
- CMOS Schmitt triggered inputs
- High serial data transfer rate: 25MHz
- Operating supply voltage range of 4.5V to 5.5V
- Built-in power on reset and thermal protection function
- Package: SOP16 and SSOP16
- Applications: LED Displays, Variable Message Signs, LED Traffic Signs

Pin Configurations



Ordering Information

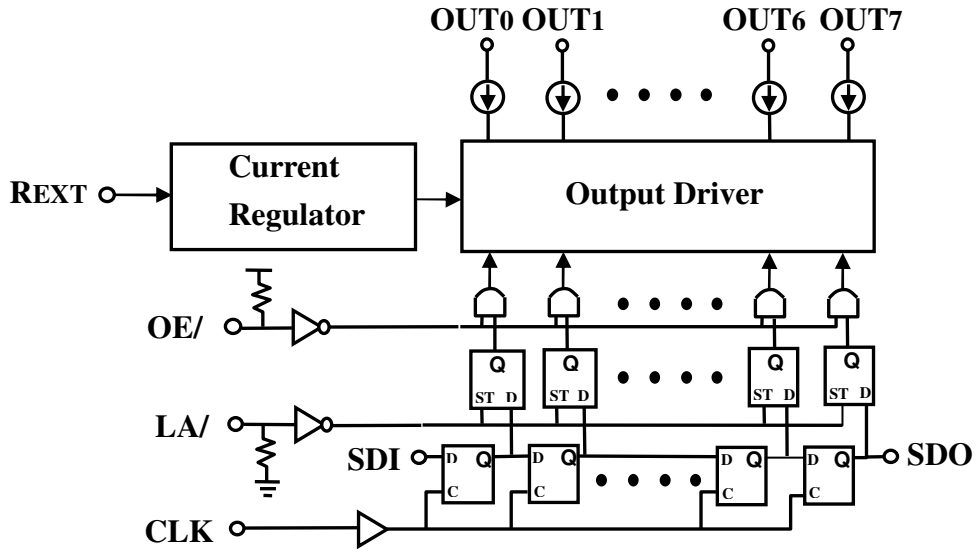
Part Number	Package
SCT2110CSOG	Pb free SOP16 (150 mil)
SCT2110CSWG	Pb free SOP16 (300 mil)
SCT2110CSSG	Pb free SSOP16

StarChips Technology, Inc.
4F, No.5, Technology Rd., Science-Based Industrial Park, Hsin-Chu,Taiwan, R.O.C.
Tel: +886-3-577-5767 # 555 Fax：+886-3-577-6575 service@starchips.com.tw

Terminal Description

Pin	Name	Function
1	GND	Ground terminal.
2	SDI	Serial input of data shift register.
3	CLK	Clock input of shift register, data is sampled at the rising edge of CLK.
4	LA/	Input terminal of data strobe. Data is latched when LA/ is low. And data on shift register goes through when LA/ is high.
5 -12	OUT[0:7]	Open-drain, constant-current outputs.
13	OE/	Output enable signal. Output is enabled when OE/ is forced to low.
14	SDO	Output terminal of serial-data output to the SDI of next SCT2110.
15	REXT	Used to connect an external resistor for setting up all output current.
16	VDD	Supply voltage terminal.

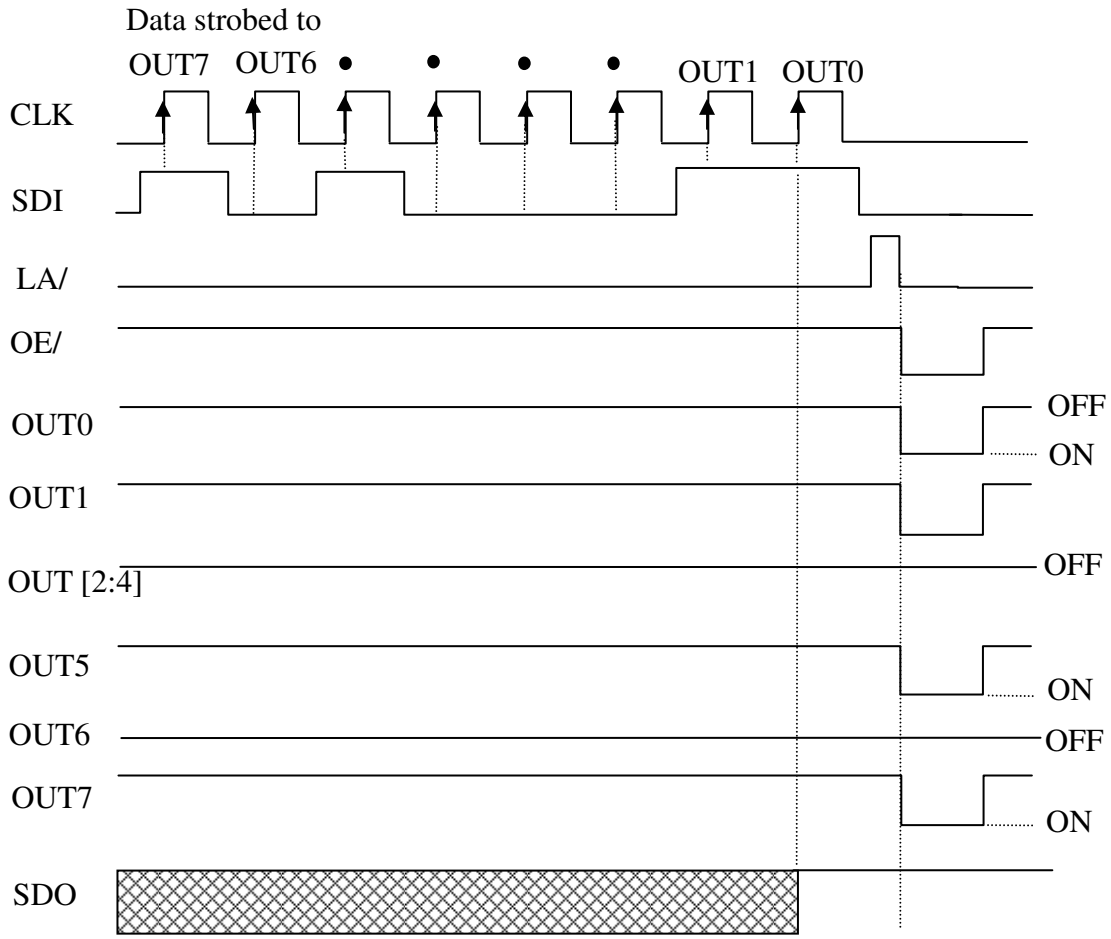
Block Diagram



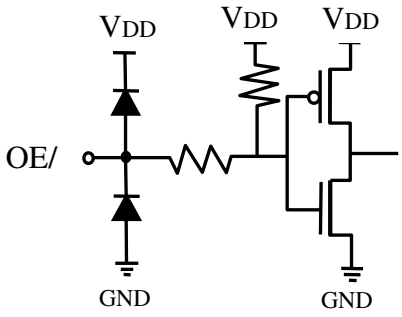
Truth Table

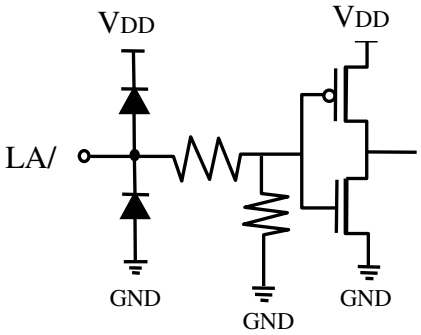
CLK	LA/	OE/	SDI	OUT0 ~ OUT7	SDO
↑	H	L	Dn	Dn Dn-1 ---- Dn-6 Dn-7	Dn-7
↑	L	L	Dn+1	No change	Dn-6
↑	H	L	Dn+2	Dn+2 Dn+1 ---- Dn-4 Dn-5	Dn-5
↓	X	L	Dn+3	Dn+2 Dn+1 ---- Dn-4 Dn-5	Dn-5
↓	X	H	Dn+3	Off	Dn-5

Timing Diagram

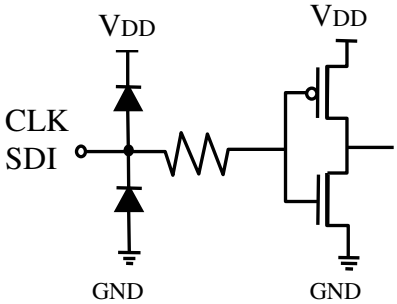


Equivalent Circuits of Inputs (1)

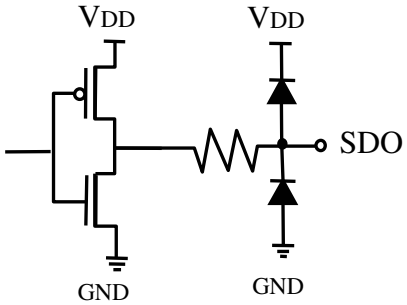




Equivalent Circuits of Inputs (2)



Equivalent Circuits of Output



Maximum Ratings (Ta = 25℃)

Characteristic		Symbol	Rating	Unit
Supply Voltage		V_{DD}	7.0	V
Input Voltage		V_{IN}	-0.2 ~ V_{DD}+0.2	V
Output Current		I_{OUT}	180	mA/Channel
Output Voltage		V_{OUT}	-0.2 ~ 17.0	V
Total GND Terminals Current		I_{GND}	1200	mA
Power Dissipation	SOP16 (150mil)	P_D	1.47	W
	SOP16 (300mil)		1.79	
	SSOP16		1.07	
Thermal Resistance	SOP16 (150mil)	$R_{TH(j-a)}$	85	℃/W
	SOP16 (300mil)		70	
	SSOP16		117	
Operating Temperature		T_{OPR}	-40~+85	℃
Storage Temperature		T_{STG}	-55~+150	℃

Recommended Operating Conditions (Ta= -40 to 85℃ unless otherwise noted)

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage	V_{DD}	-	4.5	-	5.5	V
Output Voltage	V_{OUT1}	Output OFF	-	-	17	V
Output Voltage	V_{OUT2}	Output ON	1	-	4	V
Output Current	I_{OUT}	V_{DD}=5V	5	-	160	mA
Input Voltage	V_{IH}	Input Signals	0.7V_{DD}	-	V_{DD}	V
	V_{IL}	Input Signals	0	-	0.3V_{DD}	V
OE/ Pulse Width	t_W	V_{DD}=5V	100	-	-	ns

Selector Guide

Part	Number of Outputs	Max Output Current (mA)	Min PWM Pulse Width (ns)	Supply Voltage (V)
SCT2110	8	180	100	5
SCT2167	8	60	180	3.3/5
SCT2210	16	120	50	5
SCT2026	16	90	120	5
SCT2024	16	60	180	3.3/5

Electrical Characteristics (V_{DD}=5V, Ta=25℃ unless otherwise noted)

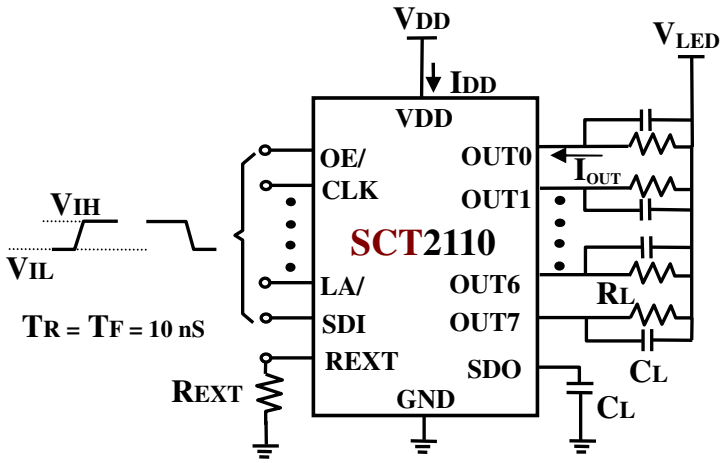
Characteristic		Symbol	Condition	Min.	Typ.	Max.	Unit
Input Voltage		V_{IH}	-	0.7V_{DD}	-	V_{DD}	V
		V_{IL}	-	0	-	0.3V_{DD}	V
SDO Output Voltage		V_{OH}	V_{DD}=5V, I_{OH} = -1mA	4.6	-	-	V
		V_{OL}	V_{DD}=5V, I_{OL} = +1mA	-	-	0.4	V
Output Leakage Current		I_{OL}	V_{OUT} = 17V	-	-	0.5	μA
Output Current		I_{OUT}	V_{OUT} = 1V, R_{EXT} = 900Ω	-	42		mA
Current Bit Skew*		dI_{OUT1}	V_{OUT} = 1V, R_{EXT} = 900Ω	-	-	±3	%
Current Chip Skew		dI_{OUT2}	V_{OUT} = 1V, R_{EXT} = 900Ω	-	-	±6	%
I_{OUT} vs. V_{DD} Regulation		%/dV_{DD}	4.5V < V_{DD} < 5.5V, V_{OUT} > 1V, R_{EXT}=900Ω	-	-	±2	%/V
I_{OUT} vs. V_{OUT} Regulation		%/dV_{OUT}	1V < V_{OUT} < 4V I_{OUT}=42mA, R_{EXT}=900Ω	-	-	±1	%/V
Pull-up Resistor		R_{up}	OE/	-	650	-	KΩ
Pull-down Resistor		R_{down}	LA/	-	650	-	KΩ
Thermal Shutdown		T_H	Junction Temperature	-	170	-	℃
		T_L		-	130	-	℃
Supply Current	OFF	I_{DD}(off)1	R_{EXT} =Open, V_{DD} = 5V OUT [0:7]=Off	-	7	9	mA
		I_{DD}(off)2	R_{EXT} = 900Ω, V_{DD} = 5V OUT [0:7]=Off	-	10	12	
	ON	I_{DD}(on)	R_{EXT} = 900 Ω, V_{DD} = 5V OUT [0:7]=On	-	11	13	

* Bit Skew=(I_{OUT}-I_{AVG})/I_{AVG}, where I_{AVG}=(I_{max}+I_{min})/2

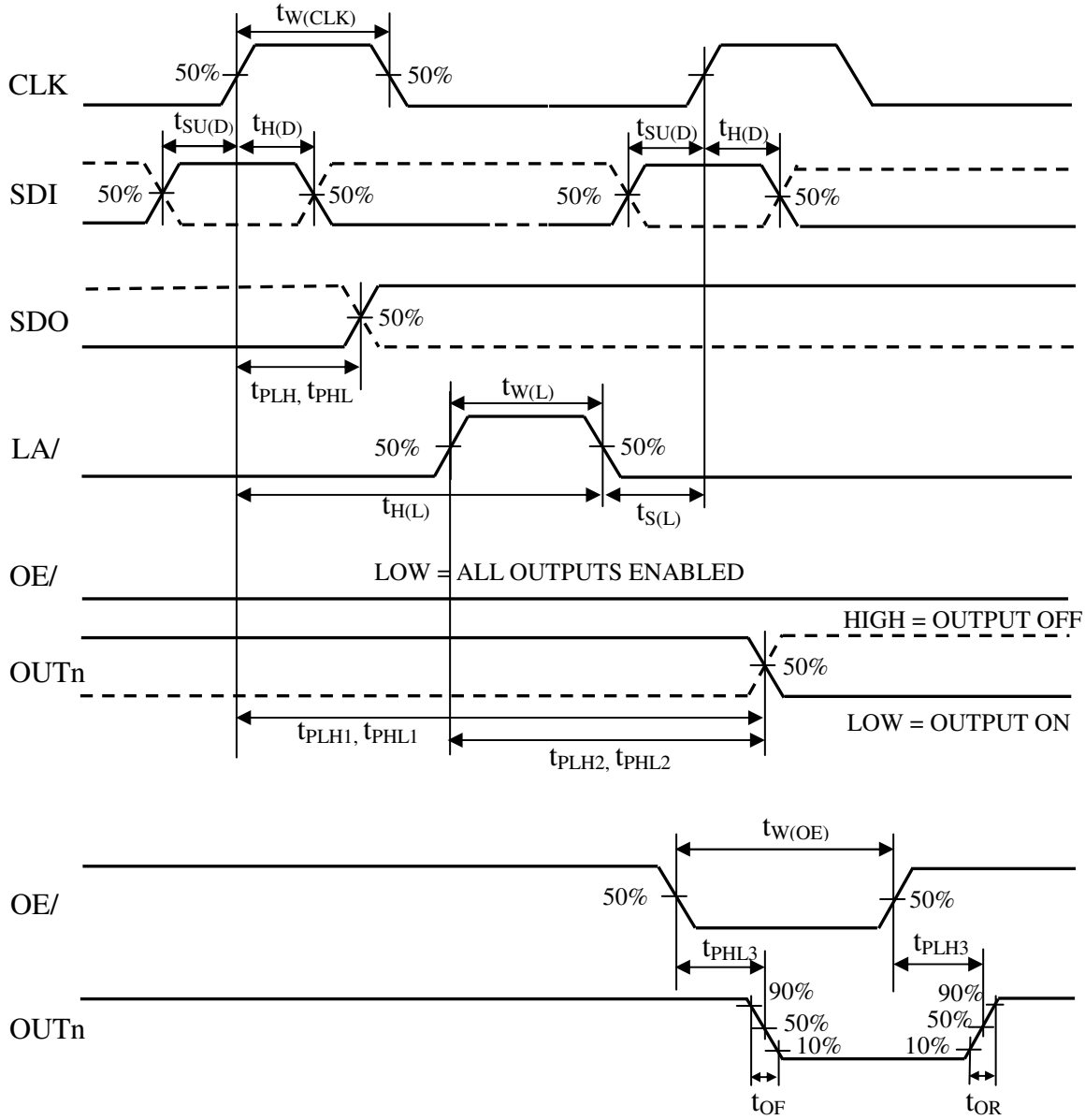
Switching Characteristics (Ta=25℃ unless otherwise noted)

Characteristic		Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time (“L” to “H”)	CLK - OUTn	t_{PLH1}	V_{DD} = 5V V_{LED} = 5V V_{IH} = V_{DD} V_{IL}= GND R_{EXT} = 900 Ω R_L = 90 Ω C_L = 10 pF	-	30	60	ns
	LA/ - OUTn	t_{PLH2}		-	100	150	ns
	OE/ - OUTn	t_{PLH3}		-	50	100	ns
	CLK - SDO	t_{PLH}		-	15	20	ns
Propagation Delay Time (“H” to “L”)	CLK - OUTn	t_{PHL1}		-	40	60	ns
	LA/ - OUTn	t_{PHL2}		-	100	150	ns
	OE/ - OUTn	t_{PHL3}		-	30	60	ns
	CLK - SDO	t_{PHL}		-	15	20	ns
Pulse Width	CLK	$t_{W(CLK)}$		20	-	-	ns
	LA/	$t_{W(L)}$		20	-	-	ns
	OE/	$t_{W(OE)}$		100			ns
Hold Time for LA/		$t_{H(L)}$		5	-	-	ns
Setup Time for LA/		$t_{S(L)}$		5	-	-	ns
Output Rise Time of I_{OUT}		t_{OR}		-	15	30	ns
Output Fall Time of I_{OUT}		t_{OF}		-	15	30	ns
Slow CLK rise time		t_R	Cascade	-	-	500	ns
Slow CLK fall time		t_F		-	-	500	ns

Test Circuit for Switching Characteristics

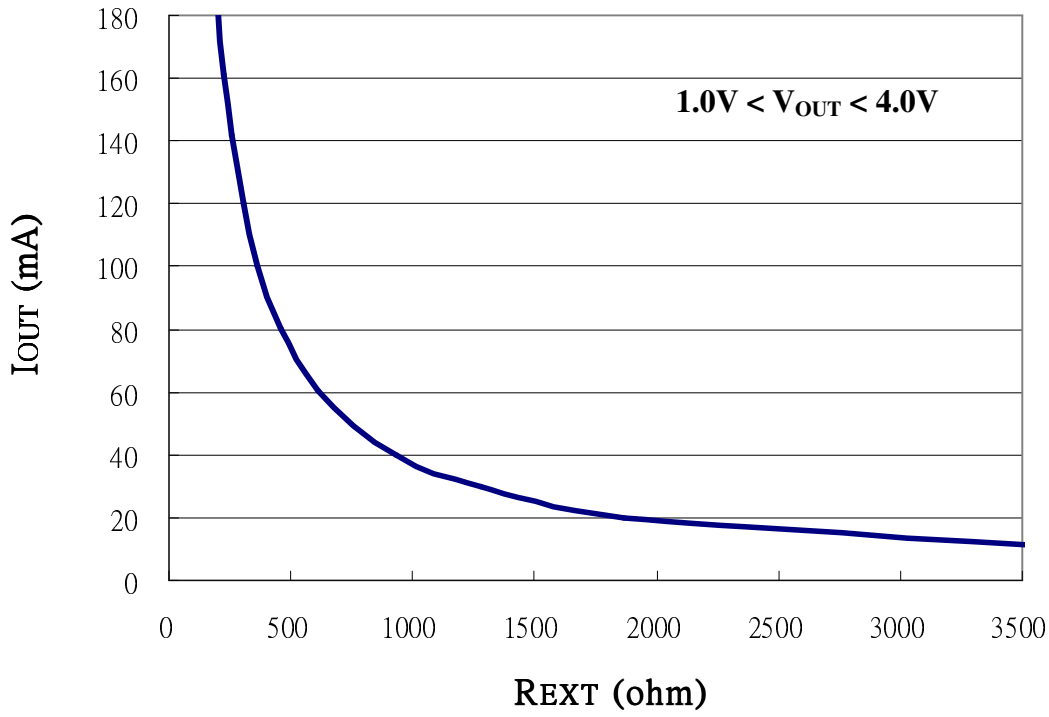


Timing Waveform



Adjusting Output Current

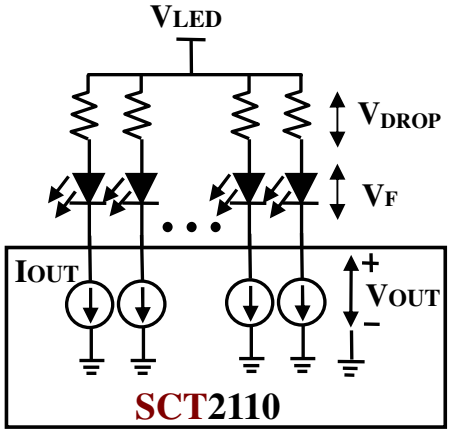
All SCT2110's output current (I_{OUT}) are set by one external resistor at pin REXT. The relationship between I_{OUT} and resistance R_{EXT} is shown as the following figure.

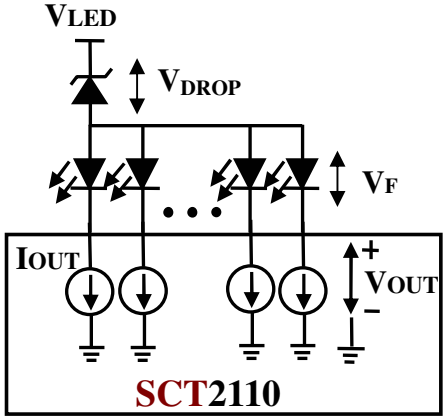


Also, when SCT2110's output voltage is set between 1 Volt and 4 Volt, the output current I_{OUT} can be set by the formula: I_{OUT} = 60(630 / R_{EXT}) (mA). Thus the output currents are all set to 42mA (±6%) by set the reference value R_{EXT} = 900Ω.

Load Supply Voltage (V_{LED})

The SCT2110 can be operated very well when V_{OUT} ranging from 1V to 4V. So it is recommended to use the lowest possible supply voltage or set a voltage reducer to reduce the V_{OUT} voltage and then reduce the power dissipation of SCT2110. A voltage reducer lets V_{OUT} = V_{LED}–V_{DROP}–V_F, Resistors or Zener diode can be used in the applications as shown in the following figures.

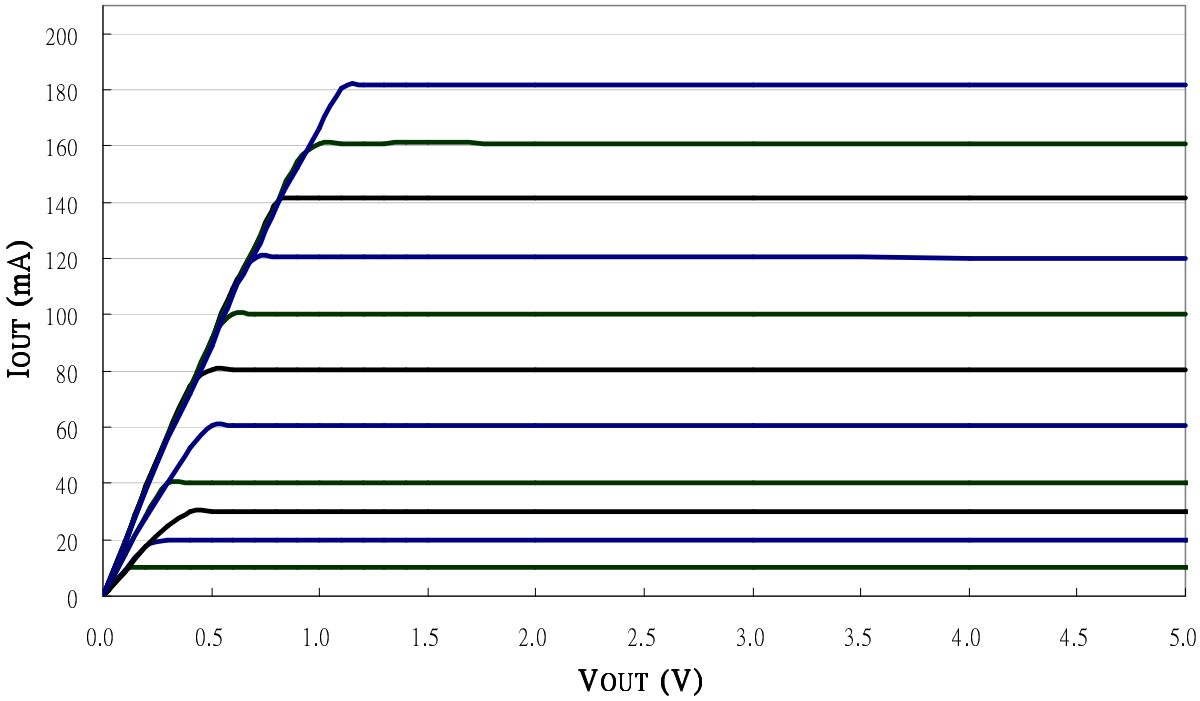




Output Characteristics

The current characteristic of output stage is flat. The output current can be kept constant regardless of the variations of LED forward voltage when V_{OUT} > 1.0V. The relationship between I_{OUT} and V_{OUT} is shown as below:

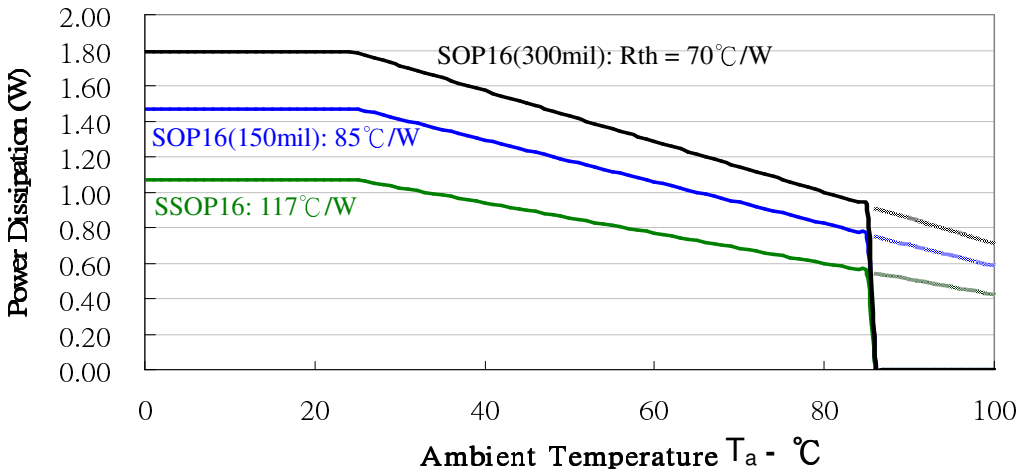
SCT2110 I_{OUT} v.s. V_{OUT} for various R_{EXT}



Power Dissipation

The power dissipation (P_D) of a semiconductor chip is limited by its package and ambient temperature. The maximum allowable power dissipation $P_{D(max)}$ is determined by $P_{D(max)}=(T_{j(max)} - T_a)/R_{th(j-a)}$ where $T_{j(max)}$: maximum chip junction temperature, usually considered as 150℃, T_a: ambient temperature, $R_{th(j-a)}$: thermal resistance of the package. The relationship between $P_{D(max)}$ and T_a is shown as the below figure:

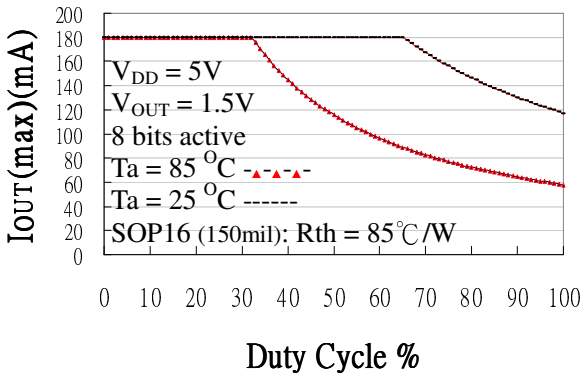
SCT2110 Max. Power Dissipation at Various Ambient Temperature

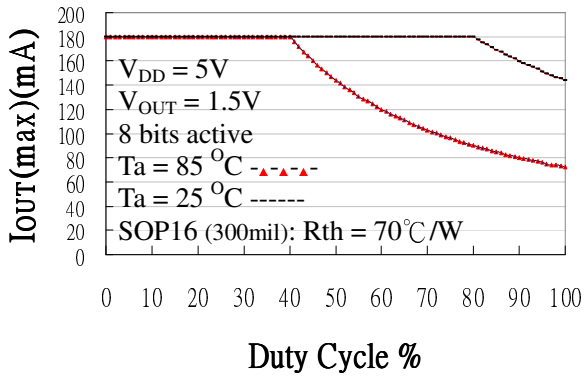


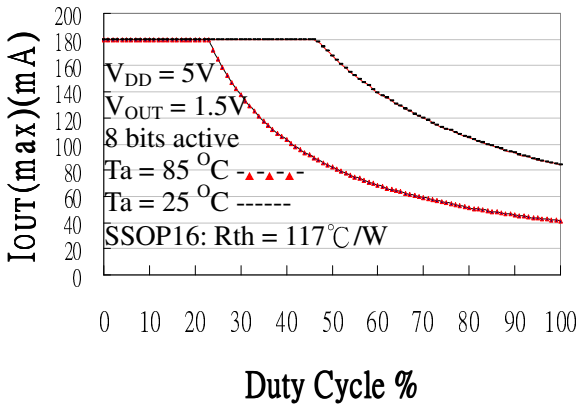
Limitation on Maximum Output Current

The maximum output current vs. duty cycle is estimated by:

$I_{OUT(max)}=(((T_{j(max)}-T_a)/R_{th(j-a)})-(V_{DD}*I_{DD}))/V_{OUT}/Duty/N$ Where $T_{j(max)}=150℃$, N=8(all ON)



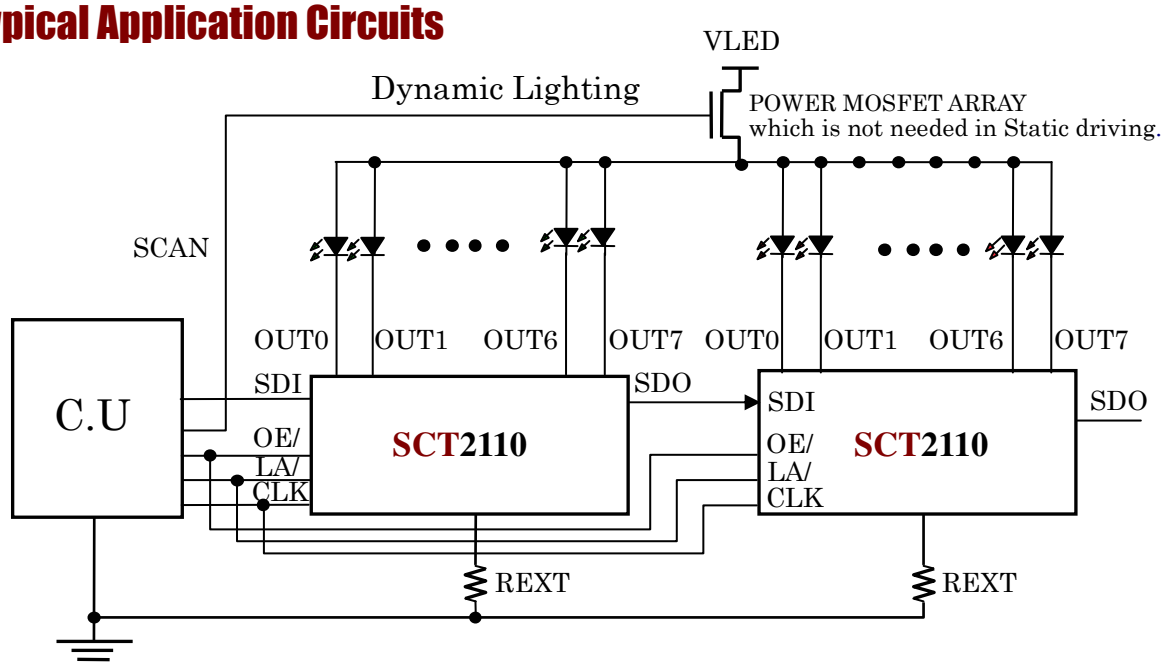




Over Temperature Shutdown

The SCT2110 contains thermal shutdown scheme to prevent damage from over heat. The internal thermal sensor turns off all outputs when the die temperature exceeds approximately +170℃. The outputs are enabled again when the die temperature drops below approximately +130℃.

Typical Application Circuits

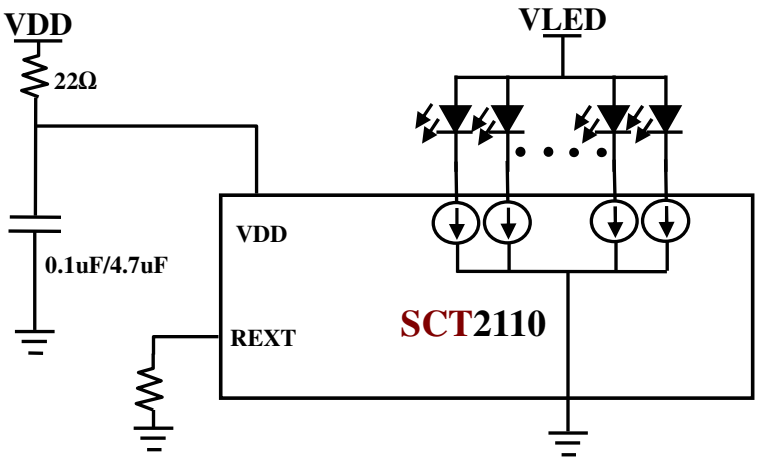


PCB Design Considerations

Use the following general guide-line when designing printed circuit boards **(**PCB**) :**

Decoupling Capacitor

Place a decoupling capacitor e.g. 0.1uF between VDD and GND pins of SCT2110. Locate the capacitor as close to the SCT2110 as possible. This is normally adequate for static LED driving. For dynamic scan or PWM applications, it is necessary to add an additional capacitor of 4.7uF or more to each supply for every SCT2110. The necessary capacitance depends on the LED load current, PWM switching frequency, and serial-in data speed. Inadequate VDD decoupling can cause timing problems, and very noisy LED supplies can affect LED current regulation.

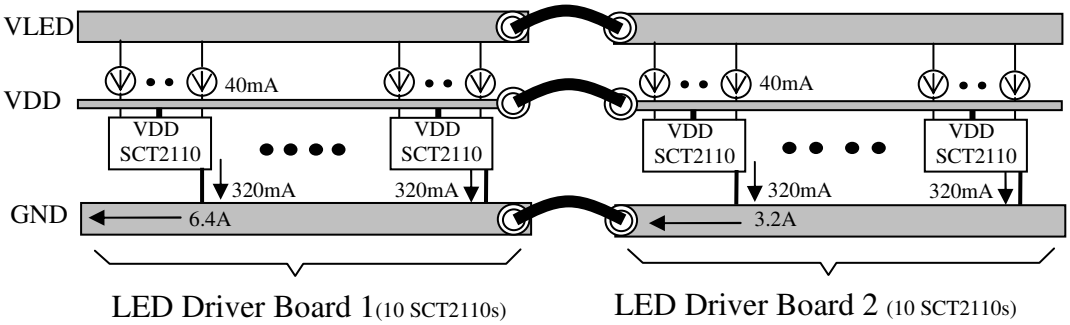


External Resistor (REXT)

Locate the external resistor as close to the REXT pin as possible to avoid the noise influence.

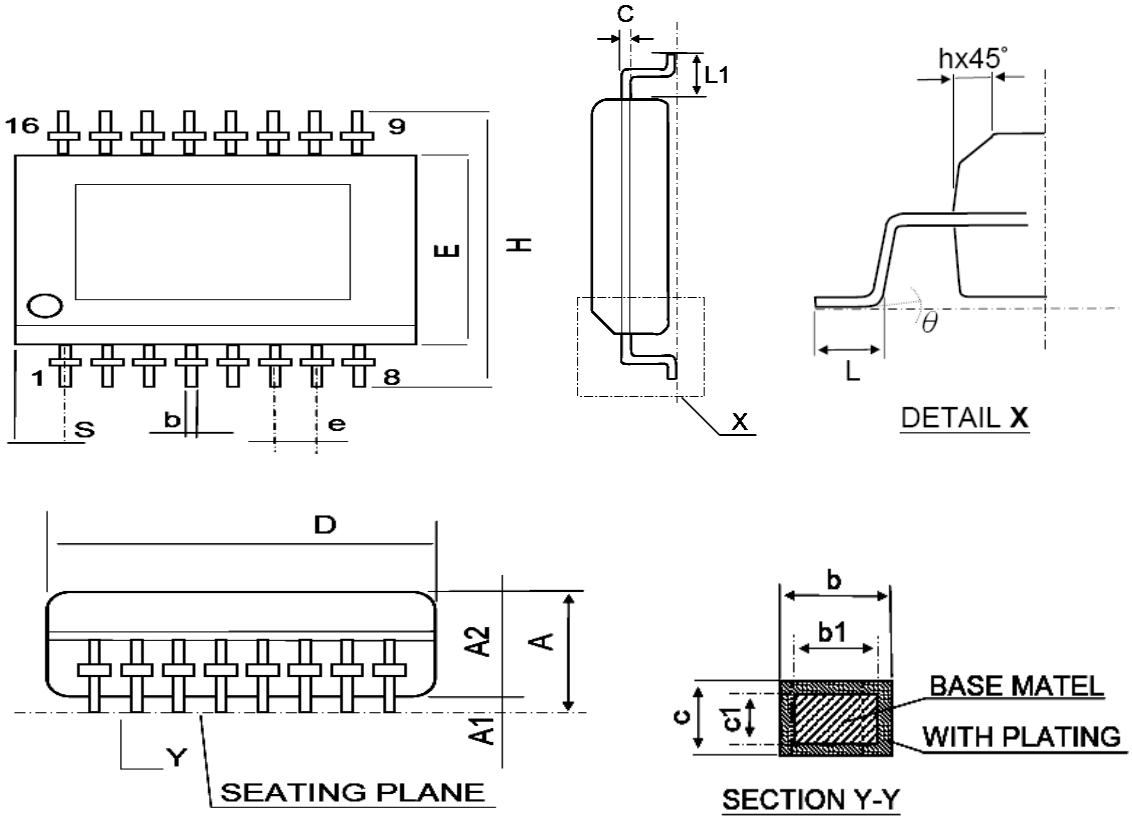
Power and Ground

Maximizing the width and minimizing the length of VDD and GND trace improve efficiency and ground bouncing by effect of reducing both power and ground parasitic resistance and inductance. A small value of resistor e.g. 22Ω series in power input pin VDD of SCT2110 in conjunction with decoupling capacitor shunting the ICs is recommended. Separating and feeding the LED power from another stable supply terminal VLED is strongly recommended.



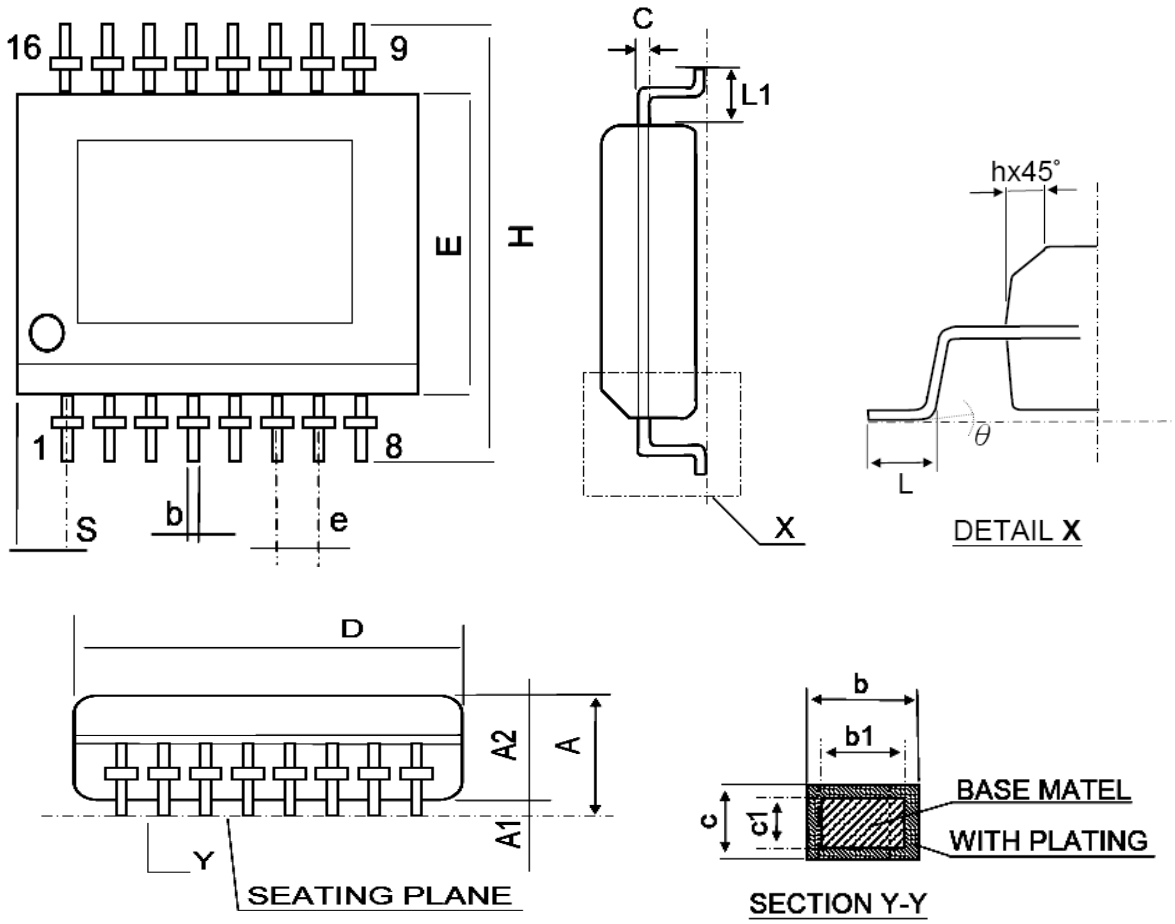
Package Dimension

SOP16 (150 mil)



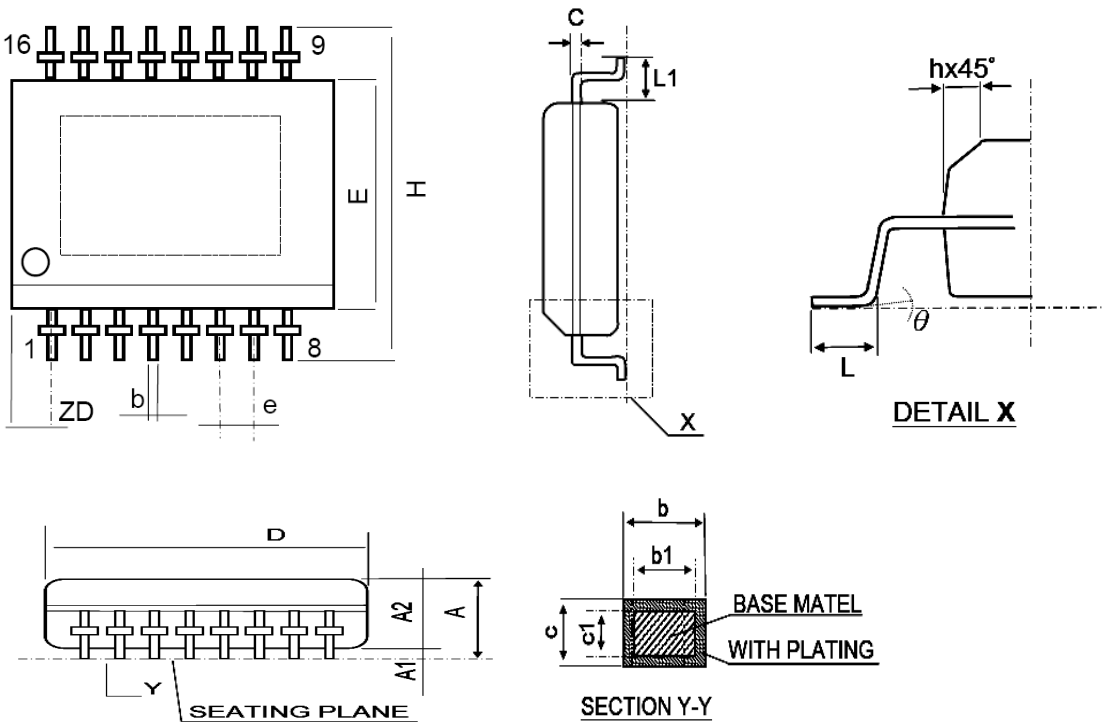
SYMBOL	DIMENSION (mm)			DIMENSION (mil)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.60	1.75	53	63	69
A1	0.10	0.15	0.25	4	6	10
A2	1.25	1.45	1.55	49	57	61
b	0.33	0.406	0.51	13	16	20
b1	0.33		0.49	13		19
c	0.19	0.203	0.25	7.5	8	10
c1	0.19		0.23	7.5		9
D	9.80	9.90	10.00	386	390	394
E	3.80	3.90	4.00	150	154	157
e		1.27 BSC			50 BSC	
H	5.80	6.00	6.20	228	236	244
h	0.25	0.42	0.50	10	17	20
L	0.40	0.66	1.27	16	26	50
L1	1.00	1.05	1.10	39	41	43
S	0.30	0.505	0.70	12	20	28
Y			0.075			3
θ	0°		8°	0°		8°

SOP16 (300 mil)



SYMBOL	DIMENSION (mm)			DIMENSION (mil)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.36	2.54	2.64	93	100	104
A1	0.10	0.20	0.30	4	8	12
A2			2.34			92
b	0.33	0.406	0.51	13	16	20
b1	0.33		0.49	13		19
c	0.19	0.203	0.25	7.5	8	10
c1	0.19		0.23	7.5		9
D	10.11	10.29	10.50	398	405	413
E	7.39	7.62	7.65	291	300	301
e		1.27 BSC			50 BSC	
H	10.00	10.31	10.65	394	406	419
h	0.25	0.42	0.50	10	17	20
L	0.40	0.66	1.27	16	26	50
L1	1.00	1.05	1.10	39	41	43
S	0.30	0.505	0.70	12	20	28
Y			0.075			3
θ	0°		8°	0°		8°

SSOP16



SYMBOL	DIMENSION (mm)			DIMENSION (mil)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.60	1.75	53	63	69
A1	0.10	0.15	0.25	4	6	10
A2			1.50			59
b	0.20	0.254	0.30	8	10	12
b1	0.20	0.254	0.28	8	10	11
c	0.18	0.203	0.25	7	8	10
c1	0.18	0.203	0.23	7	8	9
D	4.80	4.90	5.00	189	193	197
E	3.80	3.90	4.00	150	154	157
e		0.635 BSC			25 BSC	
H	5.80	6.00	6.20	228	236	244
h	0.25	0.42	0.50	10	17	20
L	0.40	0.635	1.27	16	25	50
L1	1.00	1.05	1.10	39	41	43
ZD		0.23 REF			9 REF	
Y			0.075			3
θ	0°		8°	0°		8°

Revision History

Data Sheet Version	Remark
V03_01	Upgrade spec.

Information provided by StarChips Technology is believed to be accurate and reliable. Application circuits shown, if any, are typical examples illustrating the operation of the devices. Starchips can not assume responsibility and any problem raising out of the use of the circuits. Starchips reserves the right to change product specification without prior notice.

StarChips Technology, Inc. **www.starchips.com.tw**
4F, No.5, Technology Rd., Science-Based Industrial Park, Hsin-Chu, Taiwan, R.O.C. Tel: +886-3-577-5767 # 555