12-bit Serial-In/Parallel-Out Constant Current Driver

Features

. Current regulated output channels, constant current range: 5 – 50mA
. Constant current source invariant to load voltage change
. Excellent output current matching:

Current Skew		Conditions
Bit Skew	Chip Skew	
< ±3%	< ±6%	5mA < Iout < 50mA, output voltage ≥ 1.0V

. Three groups of individual output current resistor programmable channels
. All output current can be adjusted through one external resistor if necessary
. Input interface:
- SCT2512C: 5V CMOS level, Schmitt Triggered input
- SCT2512T: 3V discrete input compatible

. Supply voltage range: 4.5V~5.5V
. Package: SOP24/SSOP24
. Applications: LED display, LED decorate lamp, and LED backlighting

Product Description

SCT2512 is designed as a current driver for the LED displays. It drives up to twelve LED clusters with regulated constant current for uniform intensity. In applications, three external resistors connected to pins of REXT0、REXT1 and REXT2 are used to set the constant output current of OUT [0:3]、OUT [4:7] and OUT [8:11] respectively in range from 5mA to 50mA.

The SCT2512 guarantees each output can endure maximum 17V DC voltage stress. The built-in shift registers and data latches making the SCT2512 effective solution in driving LED display. Since the serial data input rate at can reach to 20MHz, the SCT2512 will satisfy system which needs high volume data transmission to control the LED display.

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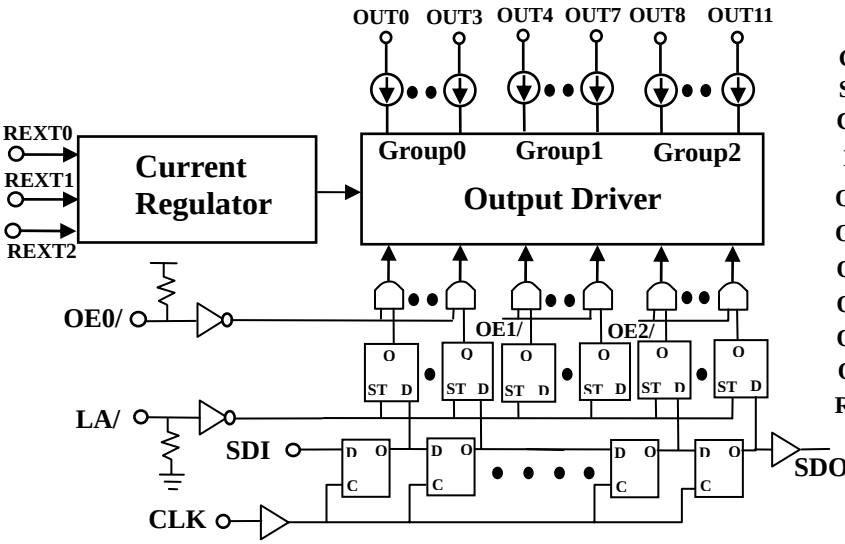
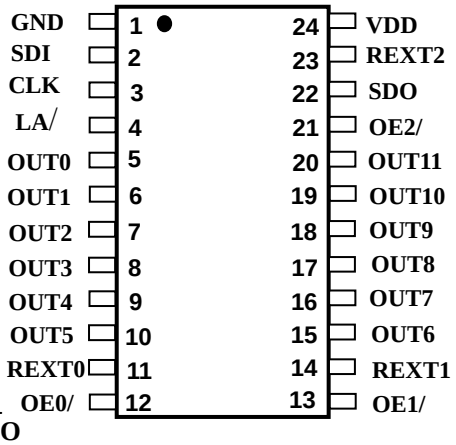
Block Diagram



Pin Configuration



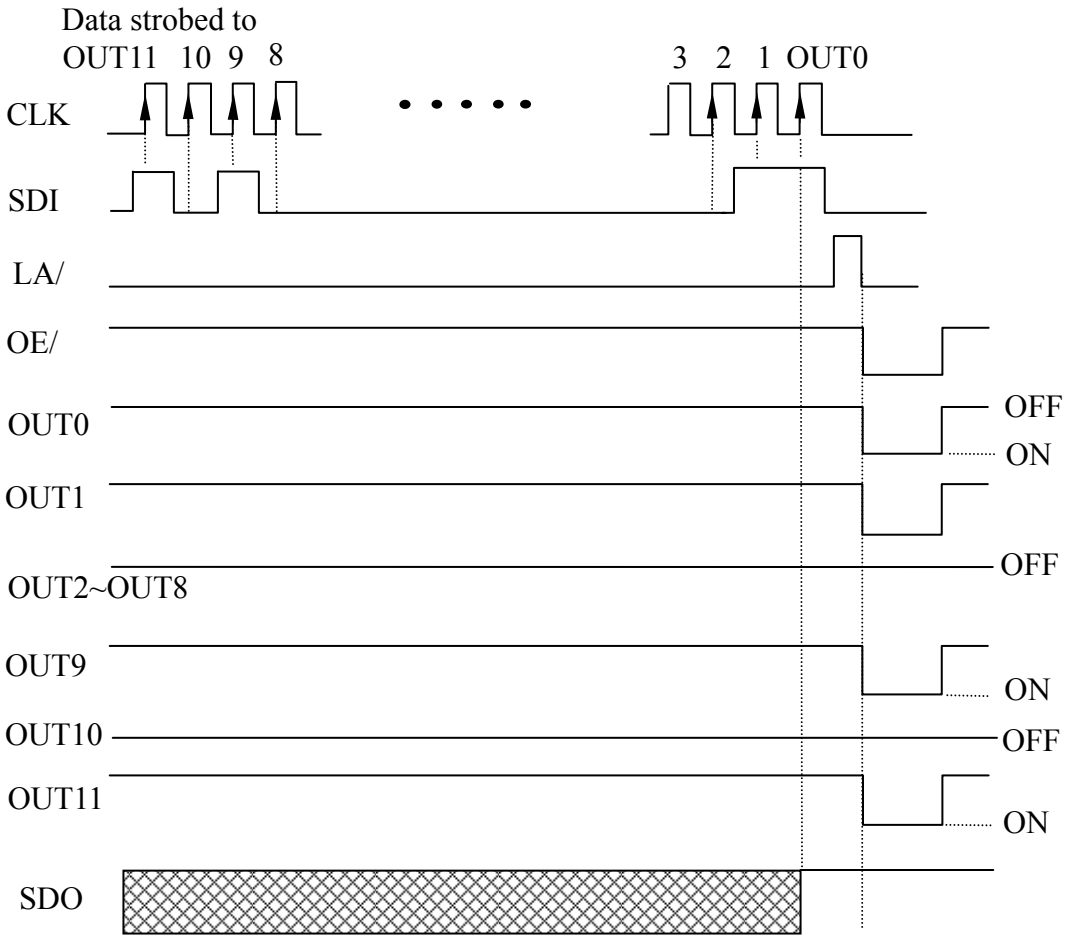
Terminal Description

Pin No.	Pin Name	Function
1	GND	Ground terminal.
2	SDI	Serial input terminal of data shift register.
3	CLK	Clock input terminal 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 ~ 10 15~20	$OUT_0 \sim OUT_5$ $OUT_6 \sim OUT_{11}$	Output terminals with constant current source.
12, 13, 21	OE0/, OE1/, OE2/	Input terminals of output enable signal. Output is enabled when OE/ is low.
22	SDO	Output terminal of serial-data output to the SDI of next SCT2512.
11, 14, 23	$REXT_0$, $REXT_1$, $REXT_2$	Input terminals used for setting up output current for each output groups.
24	V_{DD}	Supply voltage terminal.

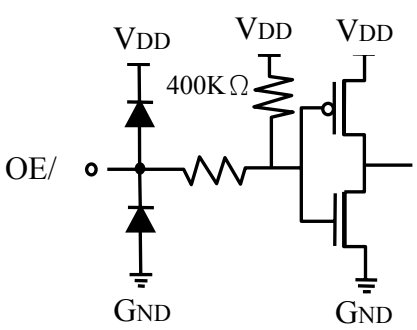
Truth Table

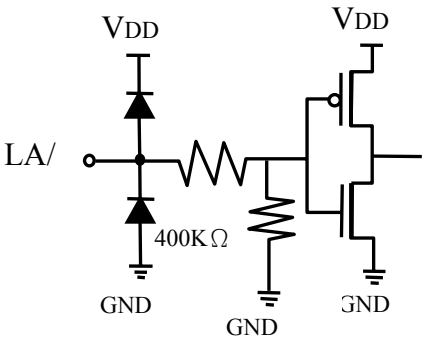
CLK	LA/	OE/	SDI	OUT0 ~ OUT11	SDO
↑	H	L	Dn	Dn Dn-1 ---- Dn-10 Dn-11	Dn-11
↑	L	L	Dn+1	No change	Dn-10
↑	H	L	Dn+2	Dn+2 Dn ---- Dn-8 Dn-9	Dn-9
↓	X	L	Dn+3	Dn+2 Dn ---- Dn-8 Dn-9	Dn-9
↓	X	H	Dn+3	Off	Dn-9

Timing Diagram

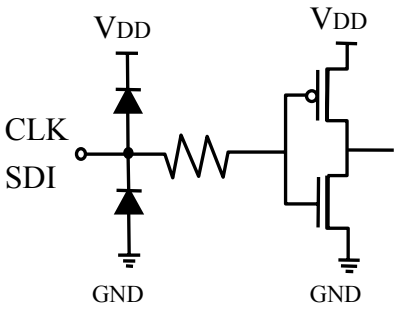


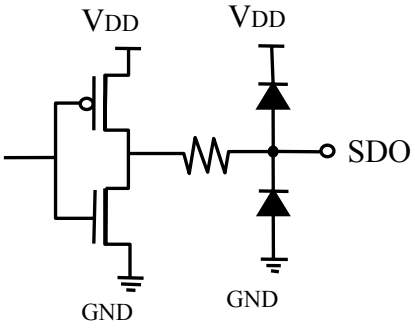
Equivalent Circuits of Inputs (1)





Equivalent Circuits of Inputs (2)





Ordering information

Part Number	Marking	Package
SCT2512CSOG	2512CSOG	Pb free SOP24
SCT2512CSSG	2512CSSG	Pb free SSOP24
SCT2512TSOG	2512TSOG	Pb free SOP24
SCT2512TSSG	2512TSSG	Pb free SSOP24

Maximum Ratings (Ta = 25 °C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V_{DD}	4.0 ~ 7.0	V
Input voltage	V_{IN}	-0.2 ~ V_{DD}+0.2	V
Output current	I_{OUT}	60	mA/Channel
Output voltage	V_{DS}	-0.2 ~ 17.0	V
Total GND terminals current	I_{GND}	800	mA
Power Dissipation	P_D	1.47	W
Thermal Resistance	$R_{TH(j-a)}$	85	°C /W
Operating temperature	T_{OPR}	-40~+85	°C
Storage temperature	T_{STG}	-55~+150	°C

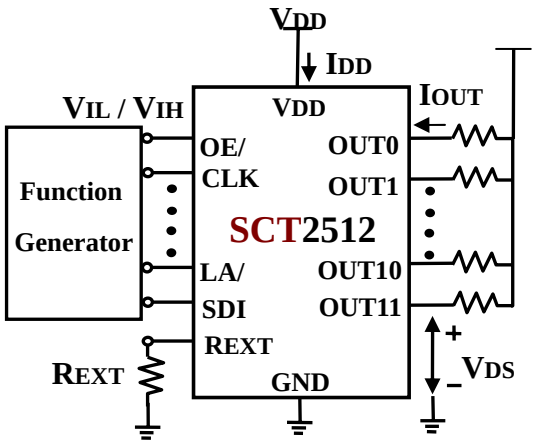
Recommended Operating Conditions (Ta=-40 to 85 °C unless otherwise noted)

Characteristic	**Symbol**	**Condition**	**Min.**	**Typ.**	**Max.**	**Unit**
Supply voltage	V_{DD}	-	4.5	5.0	5.5	V
Output voltage	V_{DS}	OUT0 ~ OUT11	1.0	-	17	V
Output current	I_{OUT}	DC test circuit	5	-	50	mA
Input voltage (SCT2512C)	V_{IH}	Input signals	0.8V_{DD}	-	V_{DD}	V
	V_{IL}	Input signals	0	-	0.2V_{DD}	V
Input voltage (SCT2512T)	V_{IH}	Input signals	2	-	V_{DD}	V
	V_{IL}	Input signals	0		0.4	V
OE/ pulse width	t_w	V_{DD}=4.5~5.5V	400	-	-	ns

Electrical Characteristics (V_{DD}=5.0V, Ta=25ºC unless otherwise noted)

Characteristic		Symbol	Condition		Min.	Typ.	Max.	Unit
Input voltage (SCT2512C)		V_{IH}			2V	-	V_{DD}	V
		V_{IL}			0	-	0.4V	V
Input voltage (SCT2512T)		V_{IH}			0.8V_{DD}	-	V_{DD}	V
		V_{IL}			0	-	0.2V_{DD}	V
Output leakage current		I_{OL}	$V_{OH} = V_{DD} = 17V$		-	0.2	0.5	µA
Output current		I_{OUT}	V_{DS}=1.0V	R_{EXT}=900 Ω	-	20	-	mA
Current bit skew		dI_{OUT}	I_{OUT}=20mA V_{DS}=1.0V	R_{EXT}=900 Ω	-	±1	±3	%
I_{OUT} vs. supply voltage regulation		%/dV_{DD}	4.5V <V_{DD} < 5.5V V_{DS} > 1.0 V		-	-	±2	%/V
I_{OUT} vs. output voltage regulation		%/dV_{DS}	1.0V < V_{DS} < 4.0V I_{OUT}=20mA, V_{DD} = 5V		-	-	±2	%/V
Supply current	OFF	$I_{DD(off)\ 1}$	R_{EXT} = Open ,V_{DD} = 5V OUT0~OUT11=Off		-	10	15	mA
		$I_{DD(off)\ 2}$	R_{EXT} = 900 Ω,V_{DD} = 5V OUT0~OUT11=Off		-	13	15	
	ON	$I_{DD(on)}$	R_{EXT} = 900 Ω,V_{DD} = 5V OUT0~OUT11=On		-	13	15	

Test Circuit for Electrical Characteristics

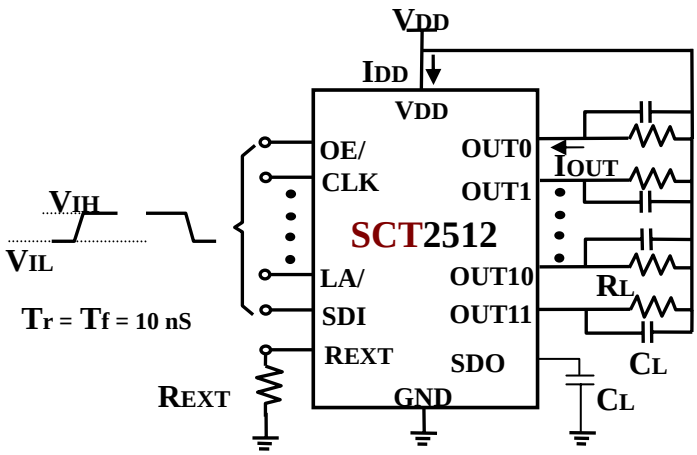


Switching Characteristics

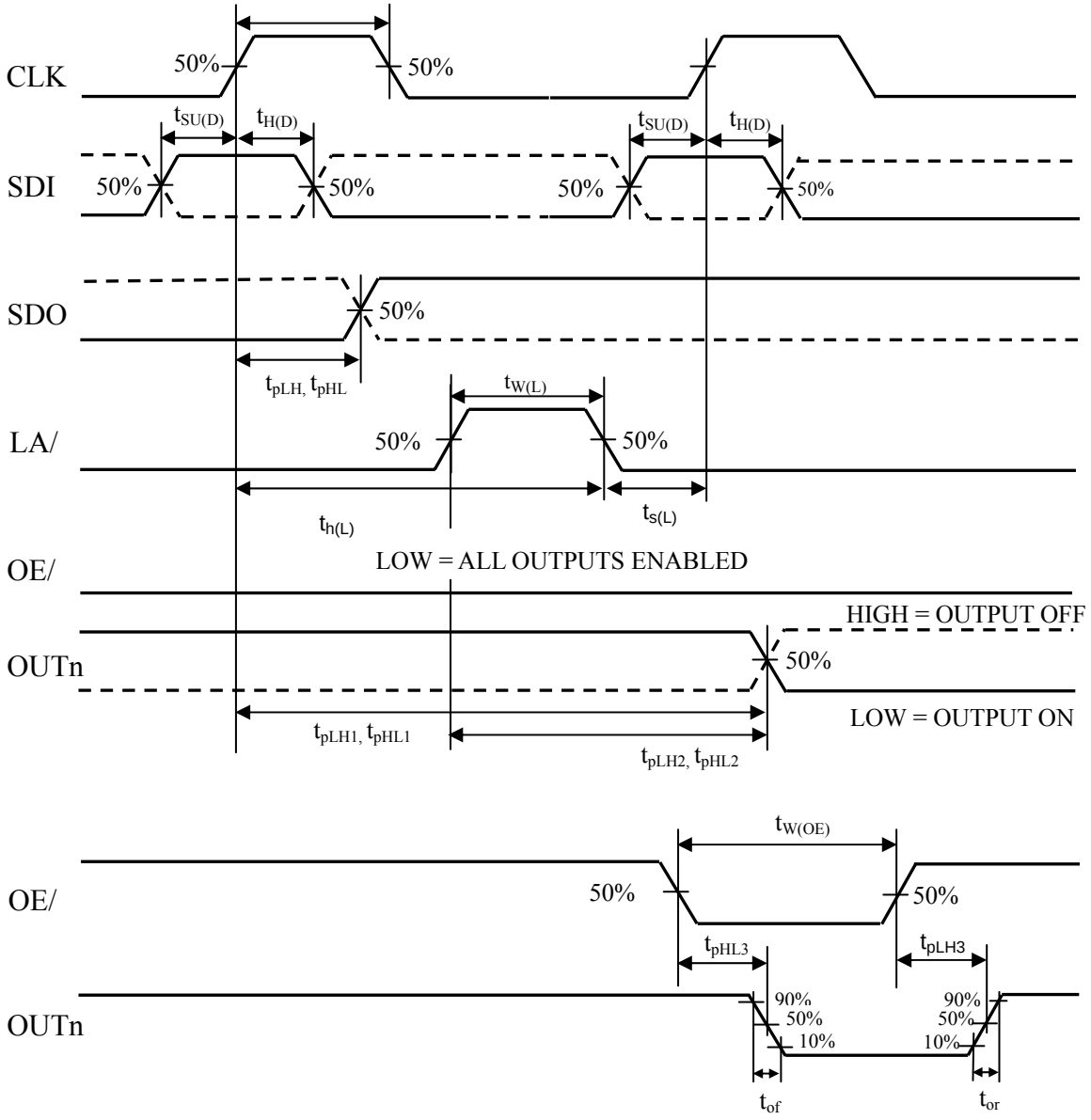
(V_{DD}=5.0V, Ta=25ºC unless otherwise noted)

Characteristic		Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation Delay Time (“L” to “H”)	CLK - OUTn	t_{pLH1}	V_{DD} = 5.0 V V_{LED} = V_{DD} V_{IH} = V_{DD} V_{IL} = GND R_{EXT} = 900 Ω R_L = 200 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	$t_{w(CLK)}$		25	-	-	ns
	LA/	$t_{w(L)}$		20	-	-	ns
	OE/	$t_{w(E)}$		400			ns
Hold Time for LA/		$t_{h(L)}$		5	-	-	ns
Setup Time for LA/		$t_{su(L)}$		5	-	-	ns
Output Rise Time of Iout		t_{or}		-	10	20	ns
Output Fall Time of Iout		t_{of}		-	10	20	ns

Test Circuit for Switching Characteristics

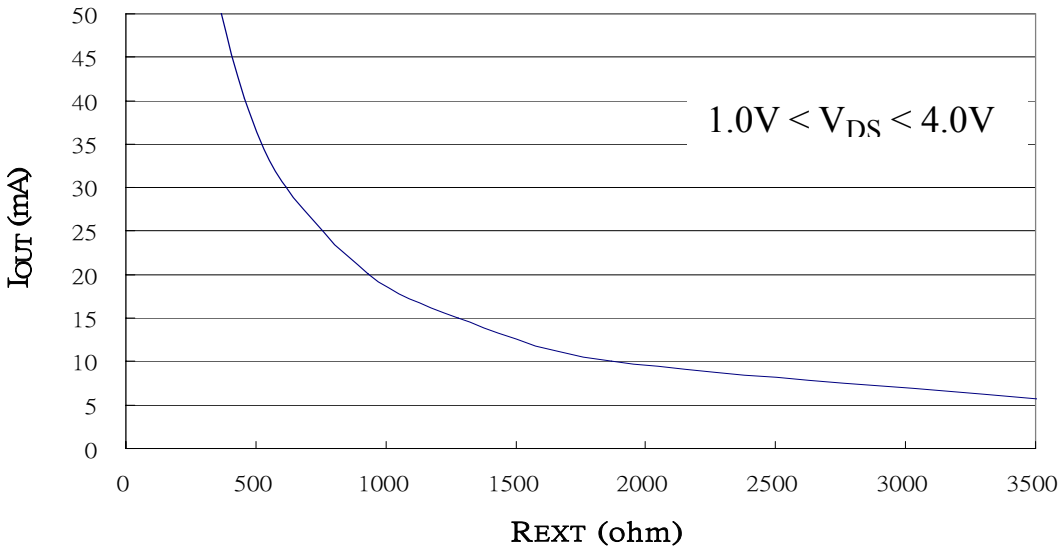


Timing Waveform



Adjusting Output Current

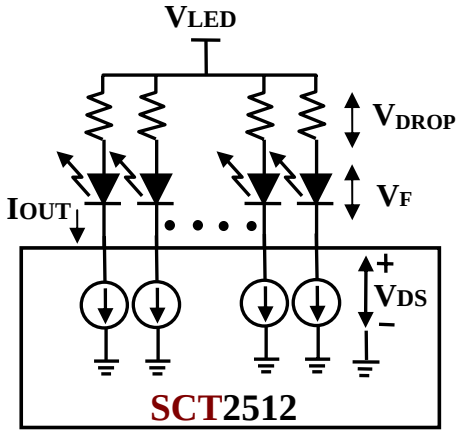
All SCT2512's output currents (I_{OUT}) are set by each external resistor at pin REXT. The relationship between I_{OUT} and resistance R_{EXT} is shown as the following figure.

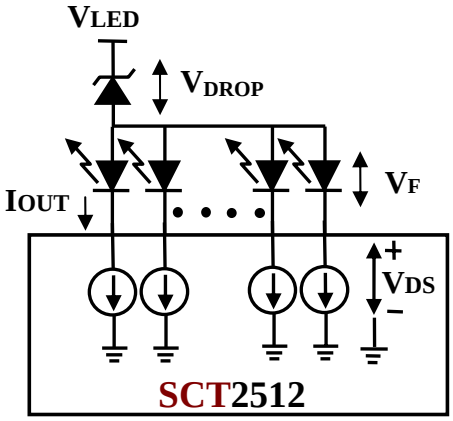


Also, when SCT2512's output voltage is set between 1.0 Volt and 4.0 Volt, the output current can be estimated approximately by: $I_{OUT} = 30(620 / R_{EXT})$ (mA) Thus the output current are all set to be about 20.6mA at $R_{EXT} = 900\Omega$.

Load Supply Voltage (V_{LED})

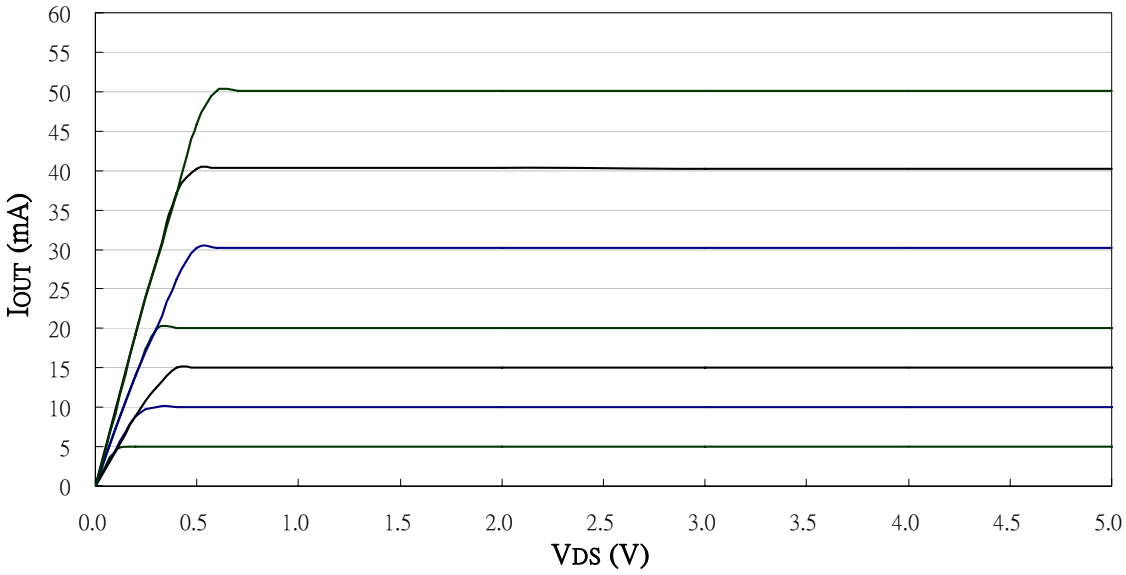
SCT2512 can operate very well when V_{DS} ranging from 1.0V to 4.0V. So it is recommended to use the lowest possible supply voltage or set a voltage reducer to reduce the V_{DS} voltage. A voltage reducer lets $V_{DS} = V_{LED}–V_{DROP}–V_F$. Resistors or Zener diode can be used in the applications as shown in the following figures.





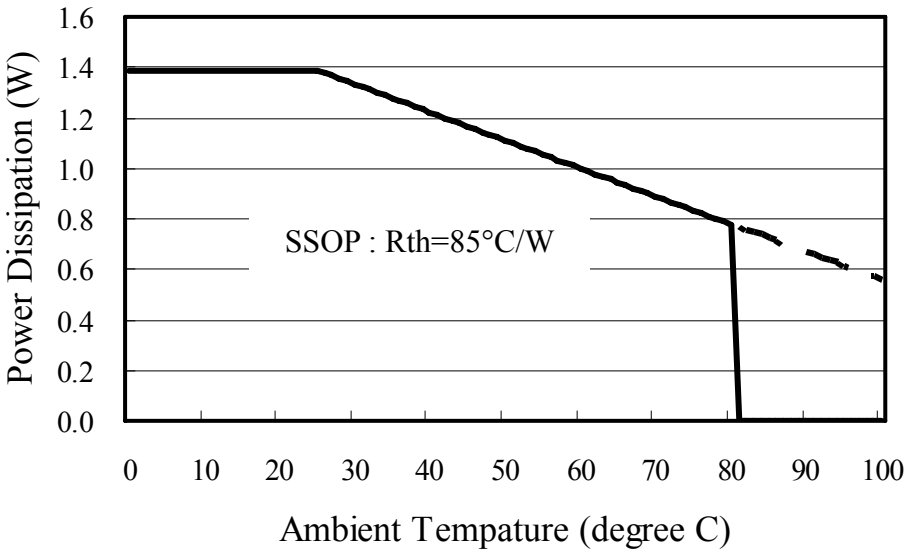
Constant Current

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



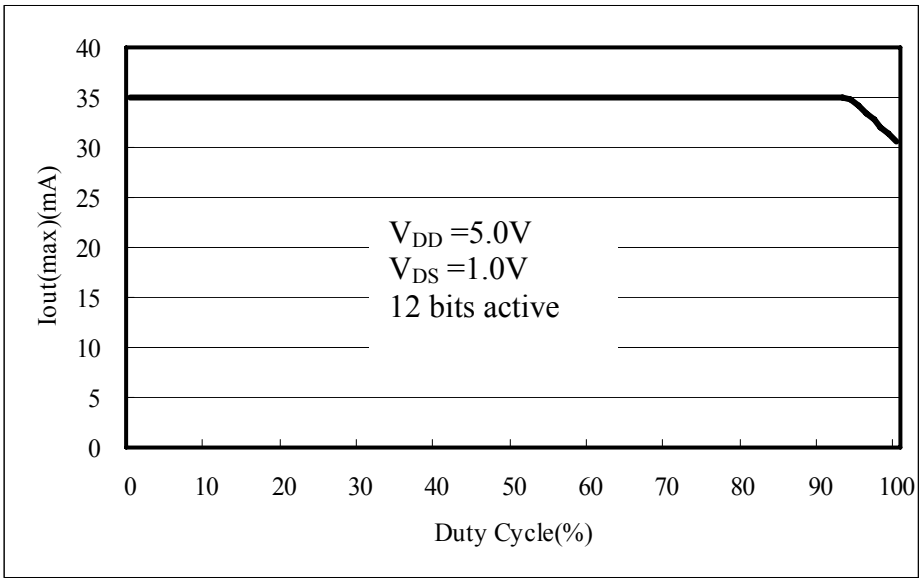
Power Dissipation

The power dissipation (P_D) of a semiconductor chip is limited by its package and ambient temperature. The maximum allowable power dissipation (P_D) is determined as $P_D(max)=(Tj - Ta)/R_{th(j-a)}$ where Tj: the chip junction temperature, Ta: ambient temperature, $R_{th(j-a)}$: thermal resistance. For SSOP packages, the relationship between P_D and Ta is shown as the following figure.



Maximum Output Current

In practical case, the SCT2512 turn on the output in partial period. So the actual package power dissipation is $P_D(act)=(I_{DD} \bullet V_{DD}) + (\#\ outputs \bullet I_{OUT} \bullet V_{DS} \bullet Duty)$. Therefore, to keep $P_D(act) \leqq P_D(max)$, the allowed maximum output current be calculated from the equation: $I_{OUT} = (P_D - I_{DD} \bullet V_{DD})/(\#\ outputs \bullet V_{DS} \bullet Duty)$ So the relationship between $I_{OUT}(max)$ and Ta is shown as the following figure:



Layout Guide

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

Decoupling Capacitor
Place a 0.1uF decoupling capacitor between VDD and GND pins of SCT2512. Locate the capacitor as close to the pins as possible.

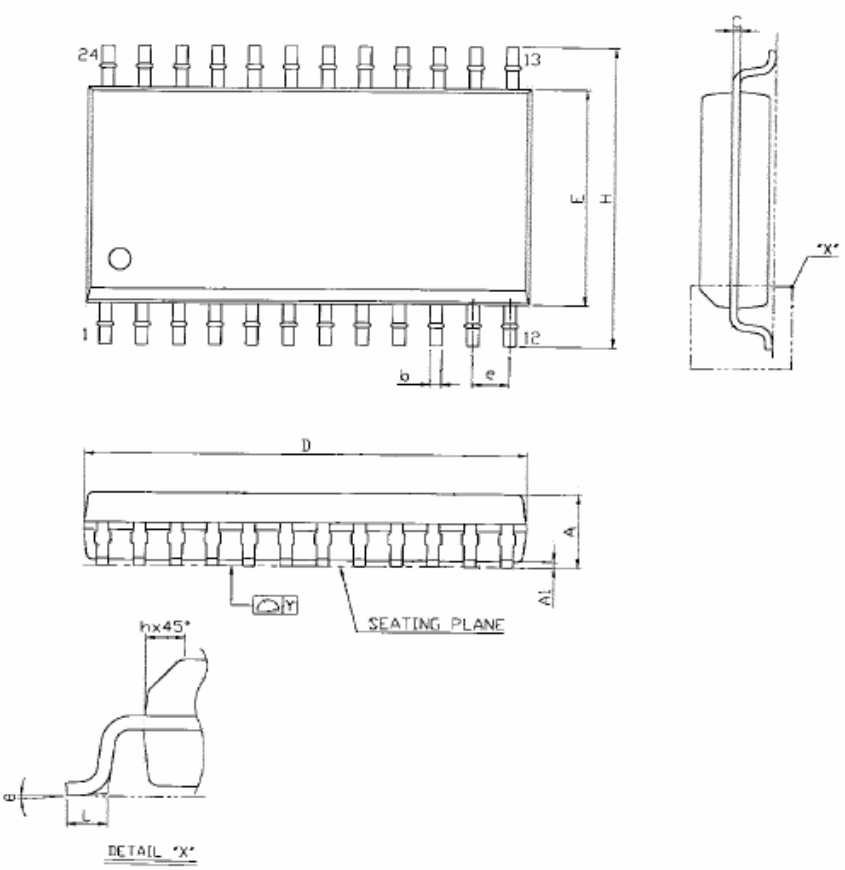
External Resistor (REXT)
Locate the external resistor as close to the REXT pin as possible to avoid the noise influence.

Current-limited Resistor
It is recommended to use 22/33 Ohm series resistors in the power connections of offending SCT2512s in conjunction with decoupling capacitors shunting the ICs.

Ground
Maximizing the width and minimizing the length of GND trace improve efficiency and ground bouncing by effect of reducing both ground parasitic resistance and inductance.

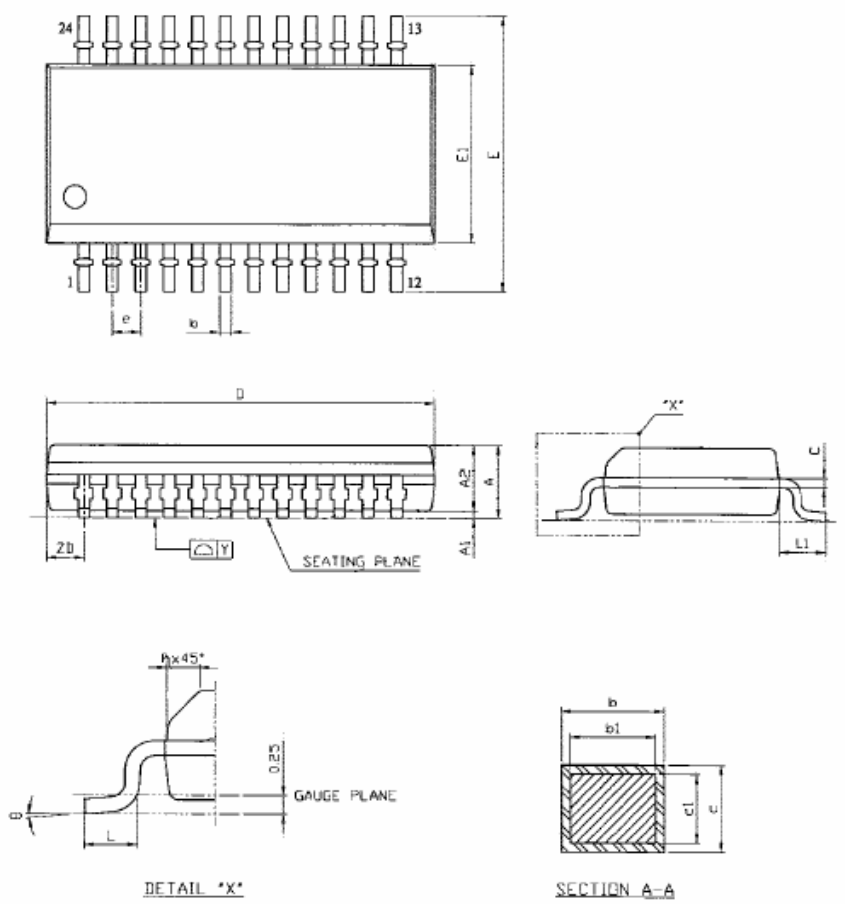
Package Dimension

SOP24



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
b	0.35	0.406	0.48	14	16	19
c	0.23	0.254	0.31	9	10	12
D	15.20	15.29	15.60	598	602	614
E	7.40	7.50	7.60	291	295	299
e		1.27 BSC			50 BSC	
H	10.00	10.31	10.65	394	406	419
h	0.25	0.66	0.75	10	26	30
L	0.51	0.76	1.02	20	30	40
Y			0.075			3
θ	0°		8°	0°		8°

SSOP24



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		0.30	8		12
b1	0.20	0.254	0.28	8	10	11
c	0.18		0.25	7		10
c1	0.18	0.203	0.23	7	8	9
D	8.56	8.66	8.74	337	341	344
E	5.80	6.00	6.20	228	236	244
E1	3.80	3.90	4.00	150	154	157
e	0.635 BSC			25 BSC		
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	0.838 REF			33 REF		
Y			0.10			4
θ	0°		8°	0°		8°