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

Features

. Fast output current control, the minimum output enable pulse width = 120ns
. Current regulated output channels, constant current range: 5 – 60mA
. Constant current source invariant to load voltage change
. Excellent output current matching:

Current Skew		Conditions
Bit Skew	Chip Skew	
< ±3%	< ±6%	5mA < Iout < 60mA, output voltage >= 1.0V

. All output current are adjusted through one external resistor
. Built-in thermal protection function
. Input interface:
  • SCT2026C: 5V CMOS level, Schmitt Triggered input
. Supply voltage range: 4.5V~5.5V
. Package: SOP24, SSOP24 and SDIP24

Product Description

SCT2026 is designed as a current driver for the LED displays. It drives up to sixteen LED clusters with regulate constant current for uniform intensity.

In applications, an external resistor is used to set the full-scale LED current from 5mA to 60mA. The SCT2026 guarantees each output can endure maximum 17V DC voltage stress. The built-in shift registers and data latches making the SCT2026 effective solution in driving LED display. Since the serial data input rate at can reach to 25MHz, the SCT2026 will satisfy system which needs high volume data transmission to control the LED display.

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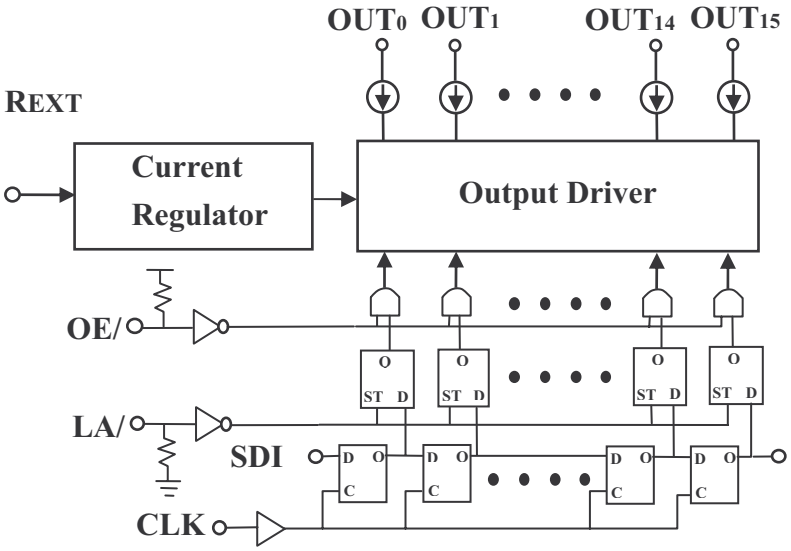
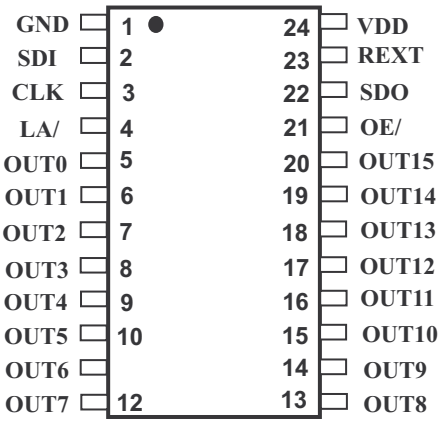
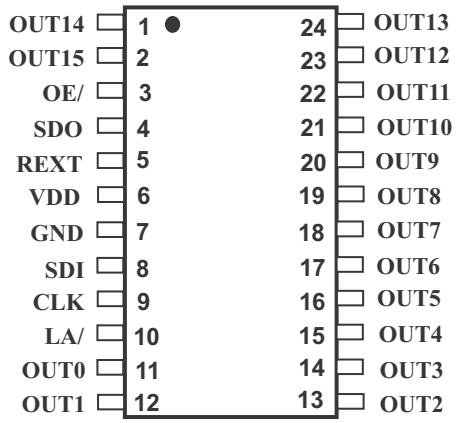
Block Diagram



Pin Configuration



SCT2026CSOG/CSSG/CSTG/CSDG



SCT2026CSAG

Ordering information

Part Number	Marking	Package	Remark
SCT2026CSOG	SCT2026CSOG	Pb free SOP24	5V CMOS input
SCT2026CSSG	SCT2026CSSG	Pb free SSOP24	5V CMOS input
SCT2026CSAG*	SCT2026CSAG	Pb free SSOP24	5V CMOS input
SCT2026CSTG	SCT2026CSTG	Pb free SOP24-1.0	5V CMOS input
SCT2026CSDG	SCT2026CSDG	Pb free SDIP24	5V CMOS input

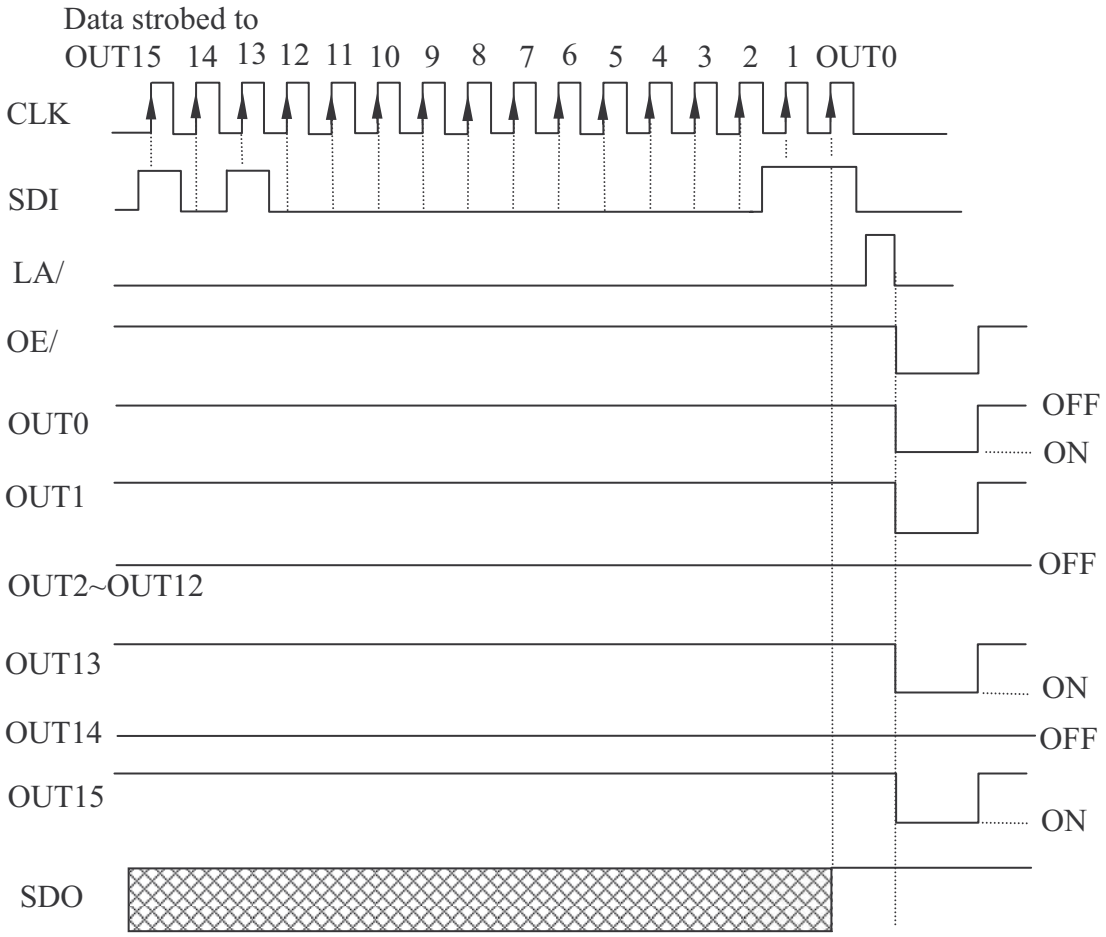
Terminal Description

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 ~ 20	$OUT_0 \sim OUT_{15}$	Output terminals with constant current.
21	OE/	Input terminal of output enable signal. Output is enabled when OE/ is low.
22	SDO	Output terminal of serial-data output to the SDI of next SCT2026.
23	R_{EXT}	Input terminal used to connect an external resistor for setting up all output current.
24	V_{DD}	Supply voltage terminal.

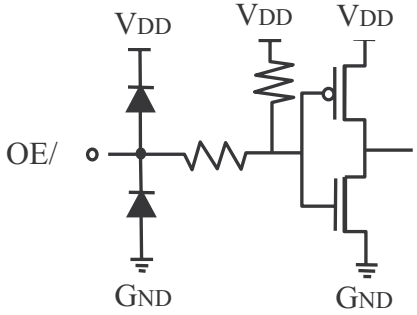
Truth Table

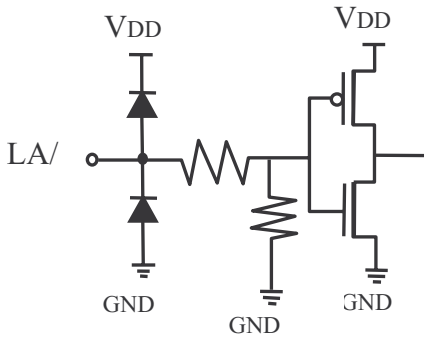
CLK	LA/	OE/	SDI	OUT0 ~ OUT15	SDO
↑	H	L	Dn	Dn Dn-1 ---- Dn-14 Dn-15	Dn-15
↑	L	L	Dn+1	No change	Dn-14
↑	H	L	Dn+2	Dn+2 Dn ---- Dn-12 Dn-13	Dn-13
↓	X	L	Dn+3	Dn+2 Dn ---- Dn-12 Dn-13	Dn-13
↓	X	H	Dn+3	Off	Dn-13

Timing Diagram

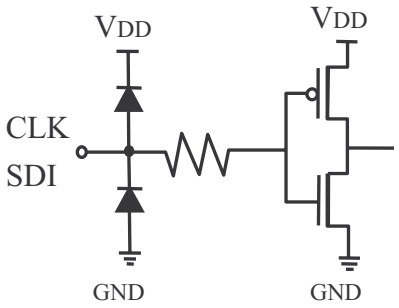


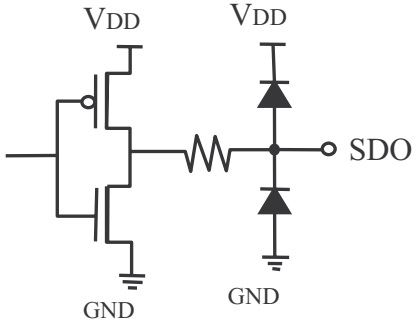
Equivalent Circuits of Inputs (1)





Equivalent Circuits of Inputs (2)





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}	80	mA/Channel
Output voltage	V_{OUT}	-0.2 ~ 17.0	V
Total GND terminals current	I_{GND}	1300	mA
Power Dissipation	P_D	1.25(Free Air) 1.78(on PCB)	W
Thermal Resistance	$R_{TH(j-a)}$	104(Free Air) 70(on PCB)	°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_{OUT}	OUT0 ~ OUT15	1.0	-	17	V
Output current	I_{OUT}	DC test circuit	5	-	60	mA
Input voltage (SCT2026C)	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}=4.5~5.5V	80	-	-	ns

Electrical Characteristics (VDD=5.0V, Ta=25ºC unless otherwise noted)

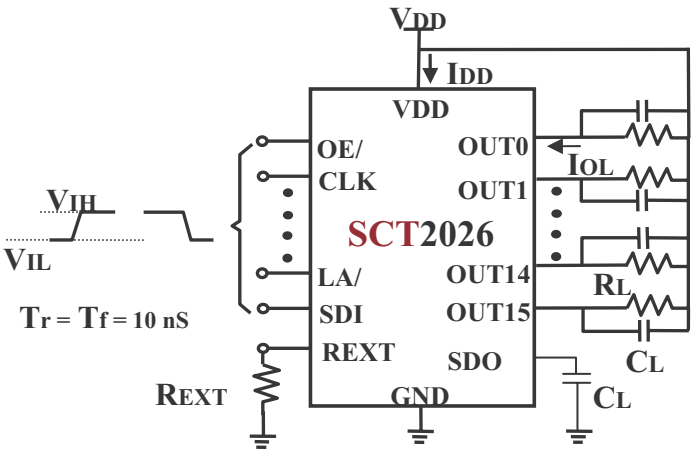
Characteristic		Symbol	Condition		Min.	Typ.	Max.	Unit
Input voltage (SCT2026C)		V_{IH}			0.7V_{DD}	-	V_{DD}	V
		V_{IL}			0	-	0.3V_{DD}	V
Output leakage current		I_{OL}	V_{OH} = V_{DD} = 7V		-	-	0.5	µA
Output current		I_{OUT}	V_{OUT}=1.0V	R_{EXT}=900 Ω	-	21	-	mA
Current bit skew		dI_{OUT}	I_{OL}=21mA, V_{OUT}=1.0V	R_{EXT}=900 Ω	-	±1	±3	%
I_{OUT} vs. supply voltage regulation		%/dV_{DD}	4.5V <V_{DD} < 5.5V, V_{OUT} > 1.0 V		-	-	±2	%/V
I_{OUT} vs. output voltage regulation		%/dV_{OUT}	1.0V < V_{OUT} < 17.0V, I_{OL}=30mA, V_{DD} = 5V		-	-	±2	%/V
Supply current	OFF	$I_{DD(off)\ 1}$	R_{EXT} = Open ,V_{DD} = 5V, OUT0~OUT15=Off		-	12	15	mA
	OFF	$I_{DD(off)\ 2}$	R_{EXT} = 900 ,V_{DD} = 5V, OUT0~OUT15=Off		-	13	15	
	ON	$I_{DD(on)}$	R_{EXT} = 900 ,V_{DD} = 5V, OUT0~OUT15=On		-	13	15	

Switching Characteristics

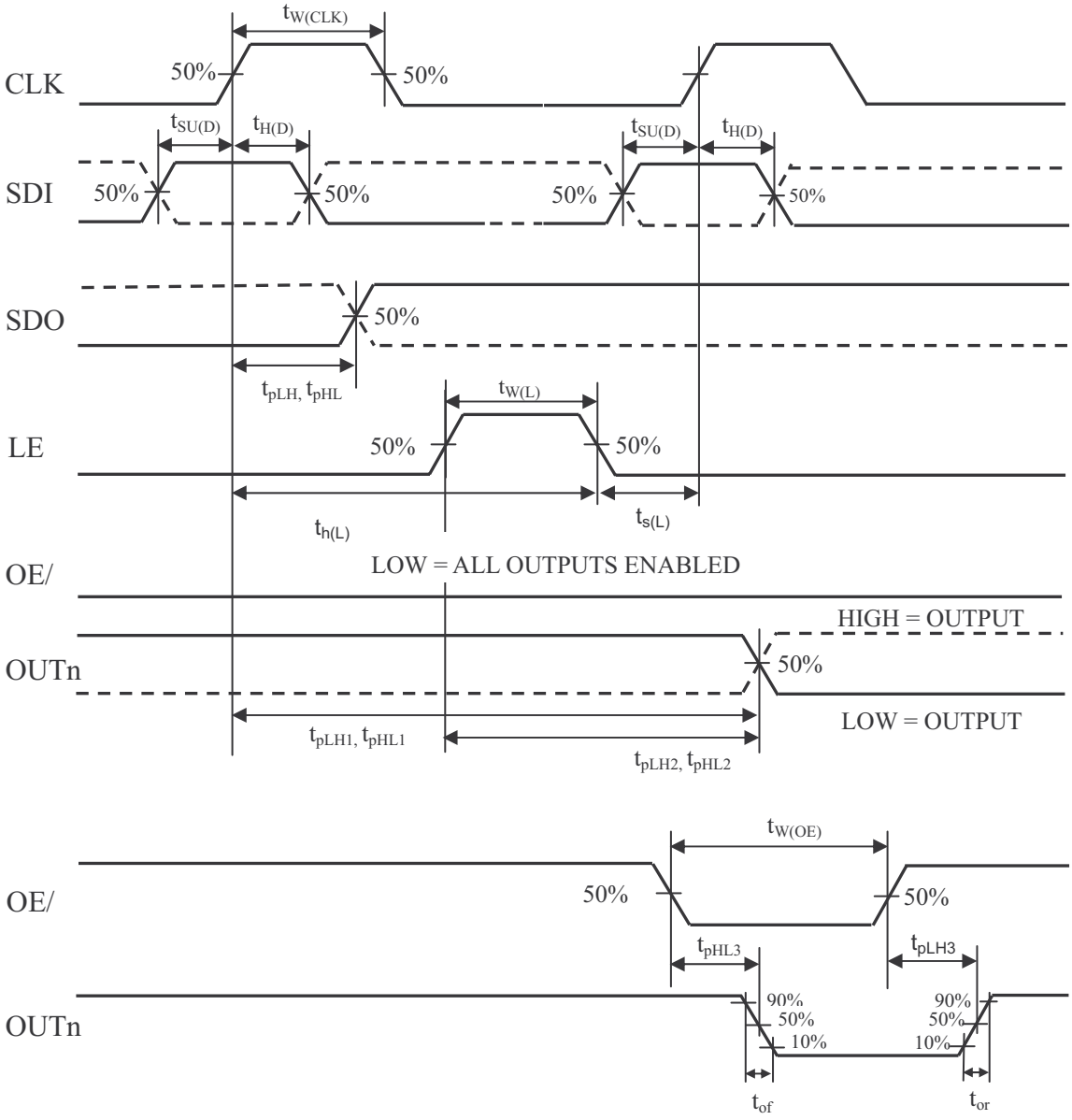
(VDD=5.0V, Ta=25ºC unless otherwise noted)

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 = 150 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/	$t_{w(E)}$		80			ns
Hold Time for LA/		$t_{h(L)}$		5	-	-	ns
Setup Time for LA/		$t_{s(L)}$		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

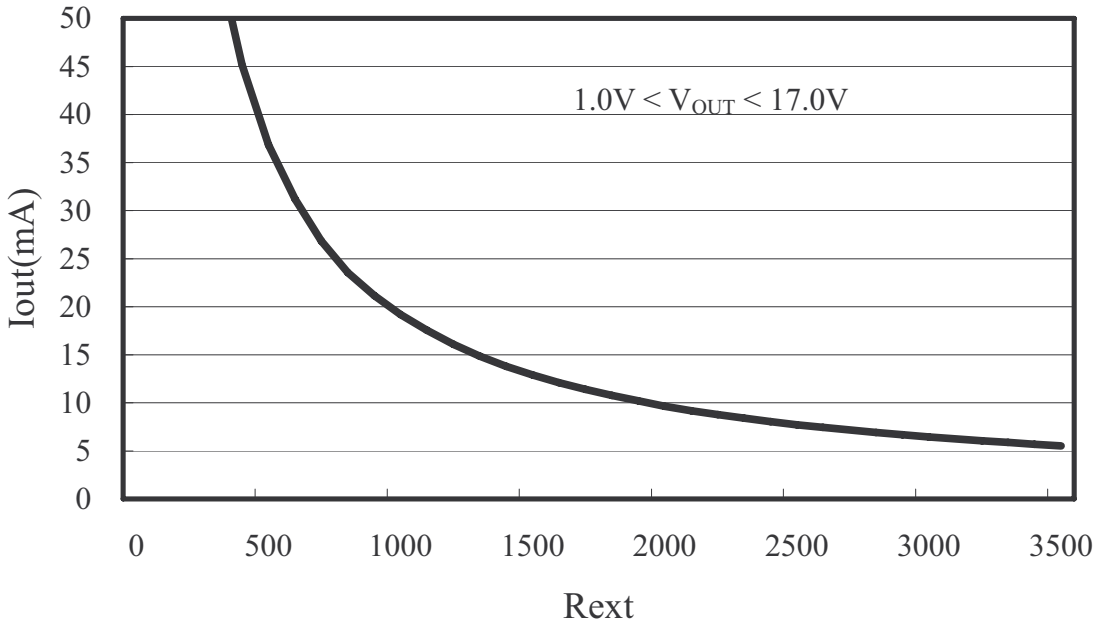


Timing Waveform



Adjusting Output Current

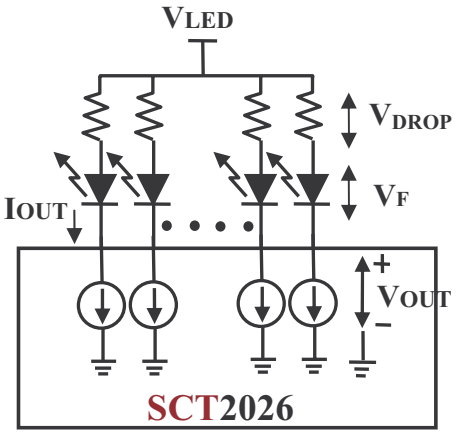
All SCT2026's output current (I_{OUT}) are set by one external resistor at pin REXT. The relationship between I_{OUT} and resistance R_{EXT} is shown as the following figure.

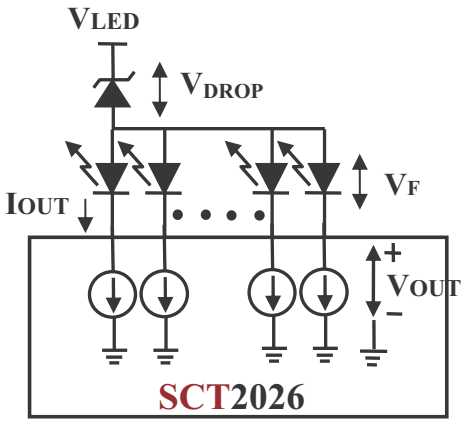


Also, when SCT2026's output voltage is set between 1.0 Volt and 17.0 Volt, the output current can be estimated approximately by: $I_{OUT} = 30(620 / R_{EXT})$ (mA)
Thus the output current are all set to be about 21mA at $R_{EXT} = 900$.

Load Supply Voltage (V_{LED})

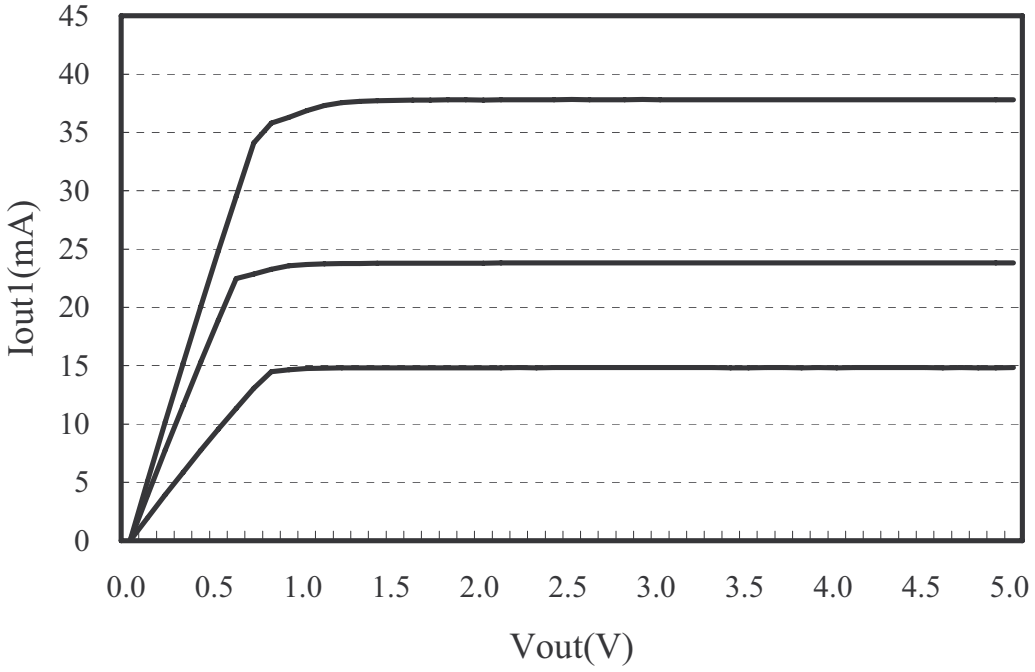
SCT2026 can operate very well only when V_{OUT} ranging from 1.0V to 17.0V. So it is recommended to use the lowest possible supply voltage or set a voltage reducer to reduce the V_{OUT} voltage. A voltage reducer lets $V_{OUT} = V_{LED} - V_{DROP} - V_F$. Resistors or Zener diode can be used in the applications as shown in the following figures.





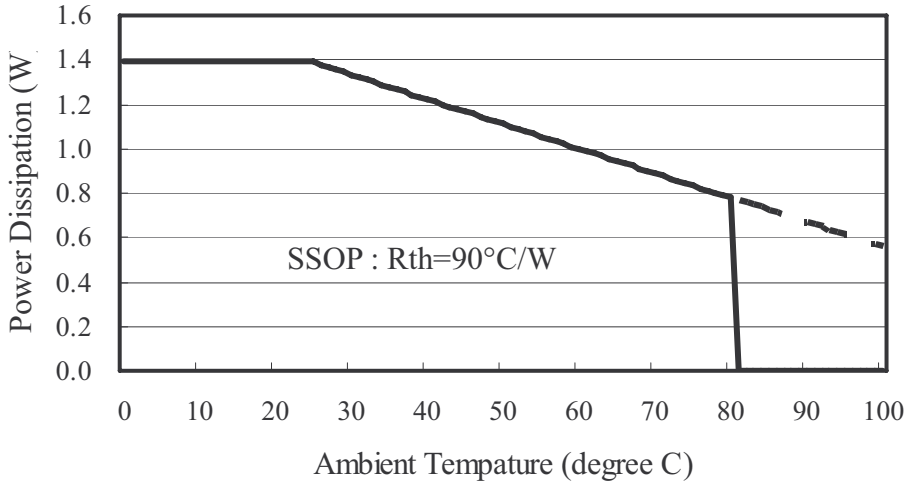
Constant Current

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



Power Dissipation

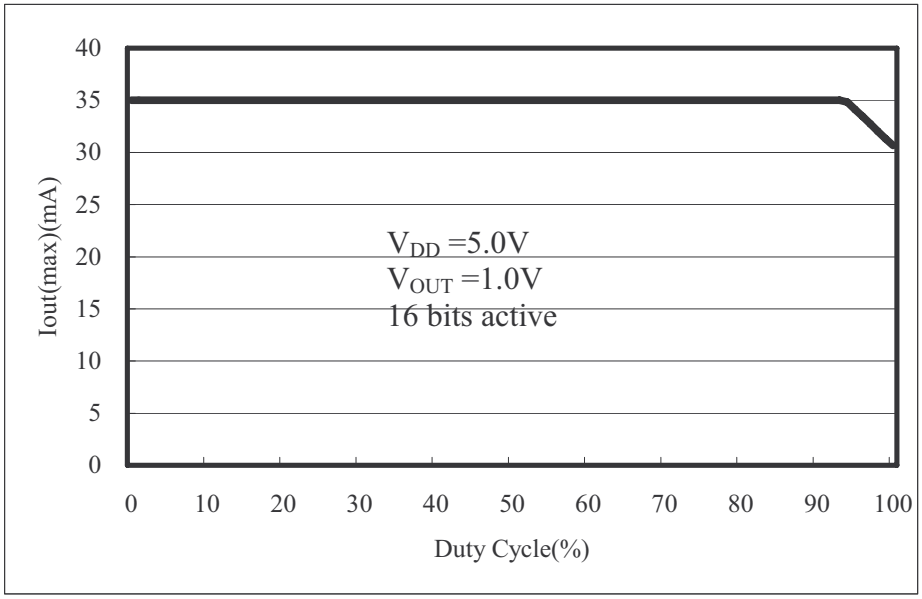
The power dissipation (P_D) of a semiconductor chip is limited by its package and ambient temperature. The maximum allowable power dissipation (P_D) is determined as $P_D(max)=(Tj - Ta)/R_{th(j-a)}$ where Tj: the chip junction temperature, Ta: ambient temperature, $R_{th(j-a)}$: thermal resistance. For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



Maximum Output Current

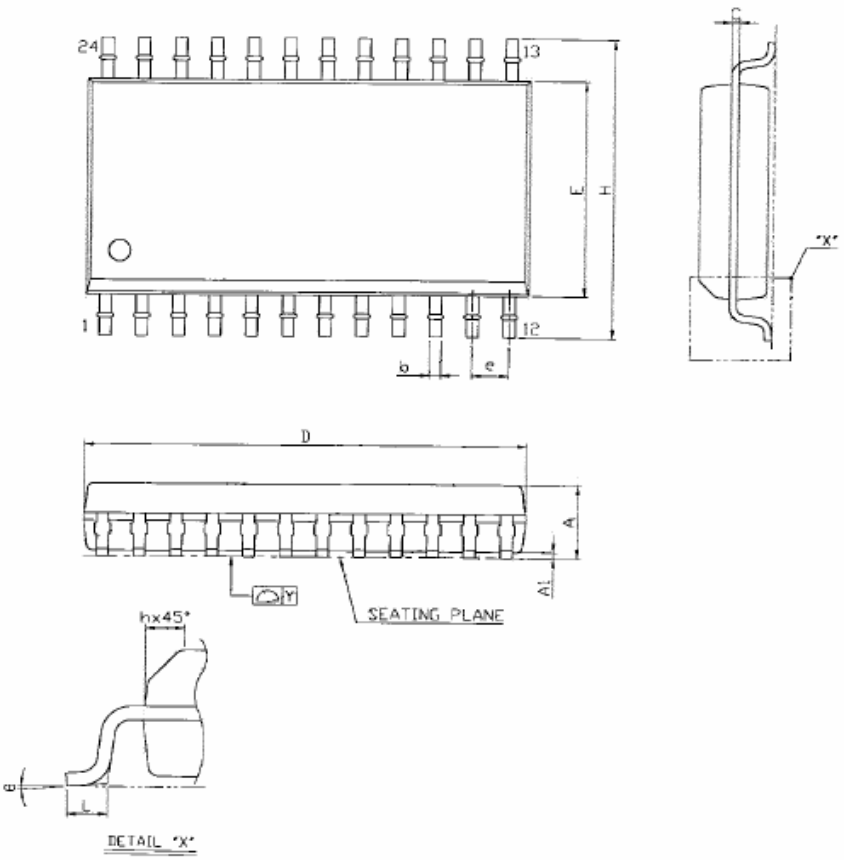
In practical case, the SCT2026 turn on the output in partial period. So the actual package power dissipation is $P_D(act)=(I_{DD} \bullet V_{DD}) + (\#\ outputs \bullet I_{OUT} \bullet V_{OUT} \bullet Duty)$. Therefore, to keep $P_D(act) \leqq P_D(max)$, the allowed maximum output current be calculated from the equation: $I_{OUT} = (P_D - I_{DD} \bullet V_{DD})/(\#\ outputs \bullet V_{OUT} \bullet Duty)$

So the relationship between $I_{OUT}(max)$ and Ta is shown as the following figure:



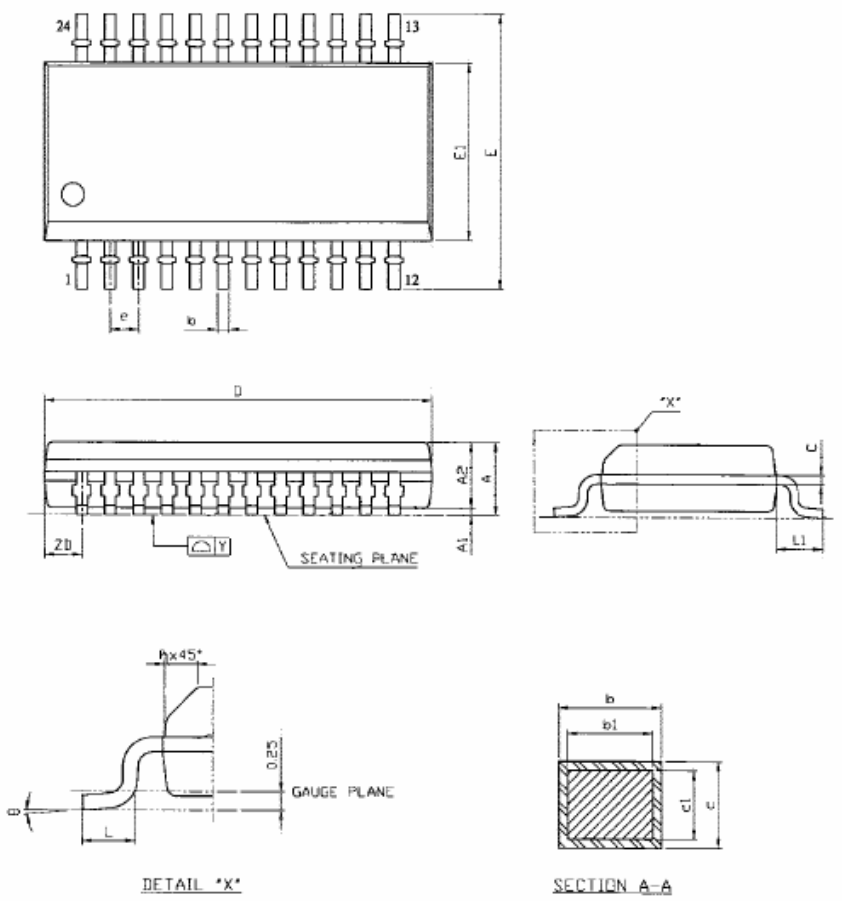
Package Dimension

SOP24



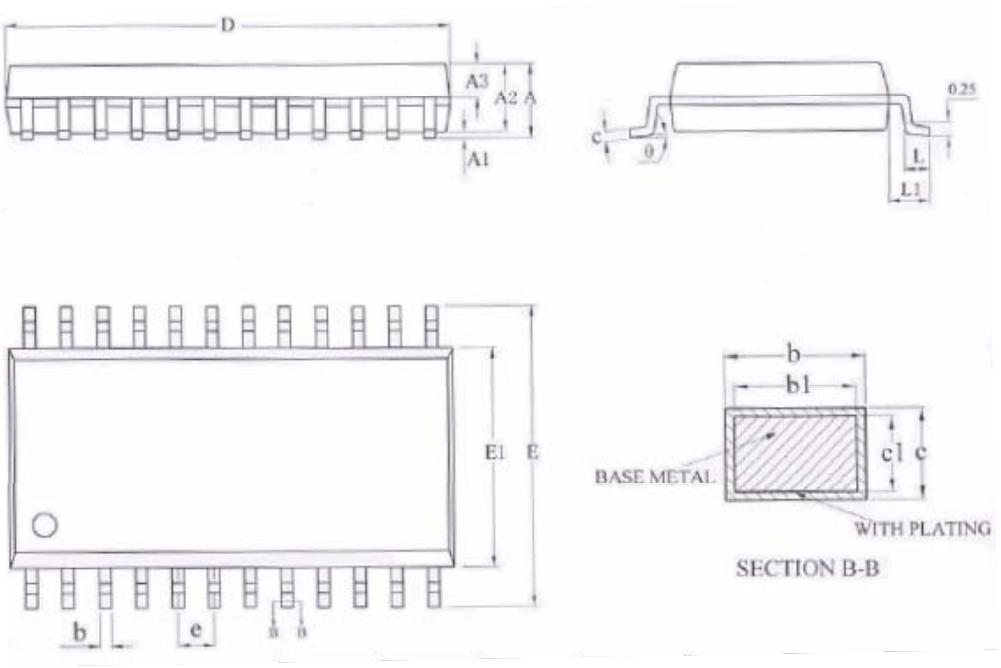
SYMBOL	DIMENSION (mm)			DIMENSION (mil)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.36	2.54	2.64	93	100	104
A1	0.10	0.20	0.30	4	8	12
b	0.35	0.406	0.48	14	16	19
c	0.23	0.254	0.31	9	10	12
D	15.20	15.29	15.60	598	602	614
E	7.40	7.50	7.60	291	295	299
e		1.27 BSC			50 BSC	
H	10.00	10.31	10.65	394	406	419
h	0.25	0.66	0.75	10	26	30
L	0.51	0.76	1.02	20	30	40
Y			0.075			3
θ	0°		8°	0°		8°

SSOP24



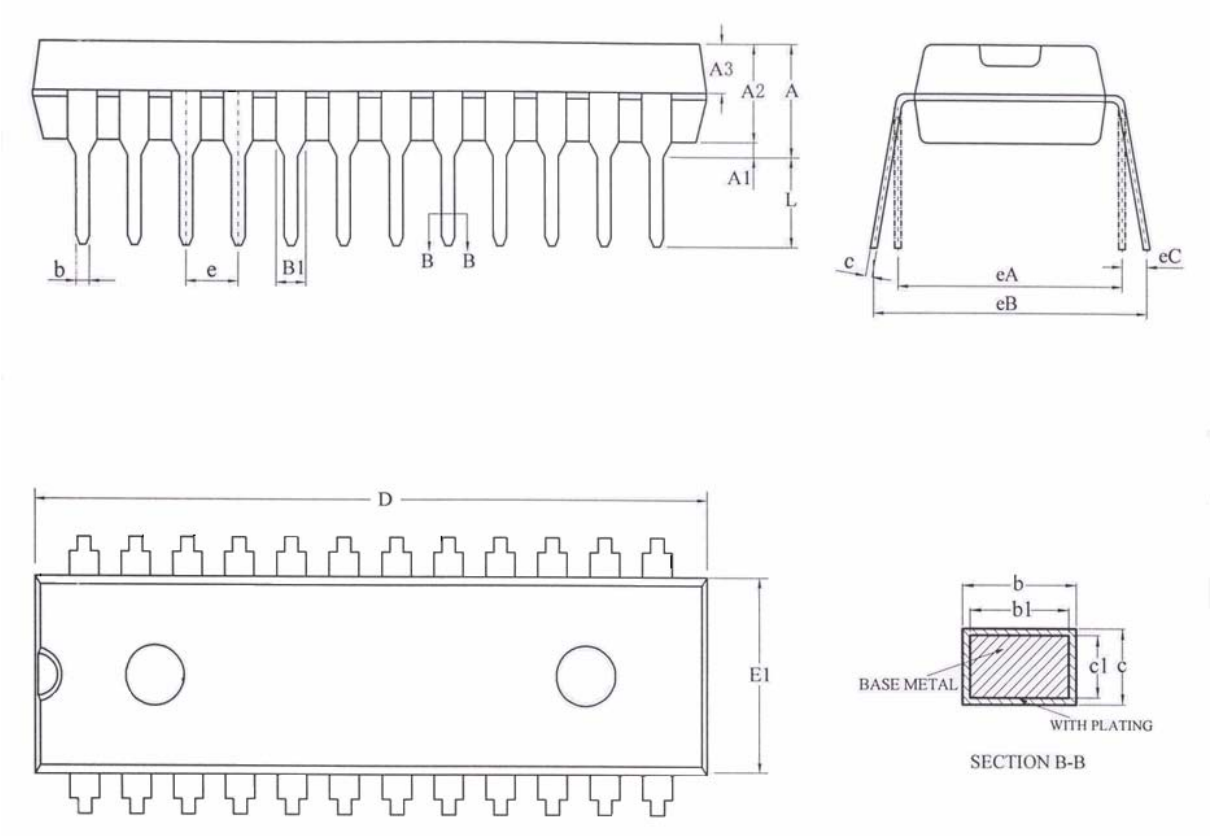
SYMBOL	DIMENSION (mm)			DIMENSION (mil)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.35	1.60	1.75	53	63	69
A1	0.10	0.15	0.25	4	6	10
A2			1.50			59
b	0.20		0.30	8		12
b1	0.20	0.254	0.28	8	10	11
c	0.18		0.25	7		10
c1	0.18	0.203	0.23	7	8	9
D	8.56	8.66	8.74	337	341	344
E	5.80	6.00	6.20	228	236	244
E1	3.80	3.90	4.00	150	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°

SSOP24-1.0



SYMBOL	DIMENSION (mm)			DIMENSION (mil)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	-	-	2.20	-	-	87
A1	0.10	0.20	0.30	4	8	12
A2	1.60	1.80	2.00	63	71	79
A3	0.62	0.82	0.92	24	32	36
b	0.39	-	0.47	15	-	19
b1	0.38	0.40	0.43	15	16	17
c	0.15	-	0.20	6	-	8
c1	0.14	0.15	0.16	5.5	6	6.5
D	12.80	13.00	13.20	504	512	520
E	7.70	7.90	8.10	303	311	319
E1	5.80	6.00	6.20	228	236	244
e		1.00 BSC			39 BSC	
L	0.35	0.45	0.55	14	18	22
L1		0.95 BSC			37 BSC	
θ	0°	-	8°	0°	-	8°

SDIP24



SYMBOL	DIMENSION (mm)			DIMENSION (mil)		
	MIN	NOM	MAX	MIN	NOM	MAX
A	3.60	3.80	4.00	142	150	157
A1	0.30	-	-	12	-	-
A2	3.10	3.30	3.50	122	130	138
A3	1.42	1.52	1.62	56	60	64
b	0.44	-	0.53	17	-	21
b1	0.43	0.46	0.48	17	18	19
B1		1.00 BSC			39 BSC	
c	0.25	-	0.31	10	-	12
c1	0.24	0.25	0.26	9	10	11
D	22.70	22.90	23.10	894	902	909
E1	6.40	6.60	6.80	252	260	268
e		1.778 BSC			70 BSC	
eA		7.62 BSC			300 BSC	
eB	7.62	-	9.50	300	-	374
eC	0	-	0.94	0	-	37
L	3.00	-	-	118	-	-