

16-Channel Constant Current Driver

Product Description

The SCT2016S is a sixteen channels constant current driver best for the LED lighting. It provides the PWM control effect by sinking constant current from LED clusters with minimum pulse width 200ns. The PWM control is performed by connecting the PWM signal from system control unit to OE pin of the SCT2016S. The full scale current value of each output is set by an external resistor connected to REXT pin.

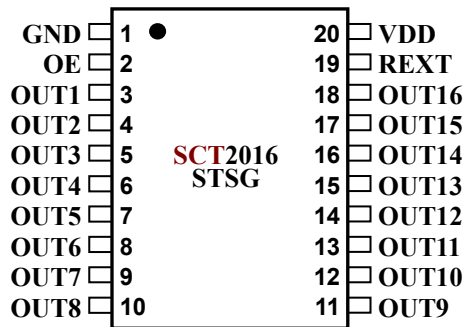
The SCT2016S guarantees to endure maximum DC 24V at each output port. Each output of SCT2016S can sink a constant current up to 45mA. Users can simply shunt the outputs to get higher current driver-ability, especially in the case of high power LED lighting.

The excellent current regulation capability allows SCT2016S easily drive each output current to a constant stable output nearly without affected by power supply of LED, loading due to variant V_F of LEDs and operating temperature. The SCT2016S is equipped with over temperature protection. The sixteen channels IC stops driving the output while sense its junction temperature exceeds the 160°C high limit and the output will be reactivated while the junction temperature is below the 110°C low limit. In conclusion, the driver system is protected from damage of overheated. Furthermore, with wide operating range, the SCT2016S can be applied to lower input supply system.

Features

- ◆ Sixteen constant-current outputs rate at 24V
- ◆ Constant current range: 5 – 45mA@5V, 5-30mA@3.3V
- ◆ Excellent regulation to load, supply voltage and temperature
- ◆ Minimum PWM pulse width 200ns
- ◆ $\pm 2\%$ (typ) current matching between outputs
- ◆ $\pm 4\%$ (typ) current matching between ICs
- ◆ Low dropout output 0.5V@20mA
- ◆ All output current are adjusted through one external resistor
- ◆ Built-in power on reset and thermal protection
- ◆ Supply voltage range 3.3V to 5V
- ◆ Dimming control with schmitt triggered input
- ◆ Interlaced 30ns delay of output to lower bouncing noise
- ◆ Package: TSSOP20
- ◆ Application: LED lighting, LED backlight, LED lamp

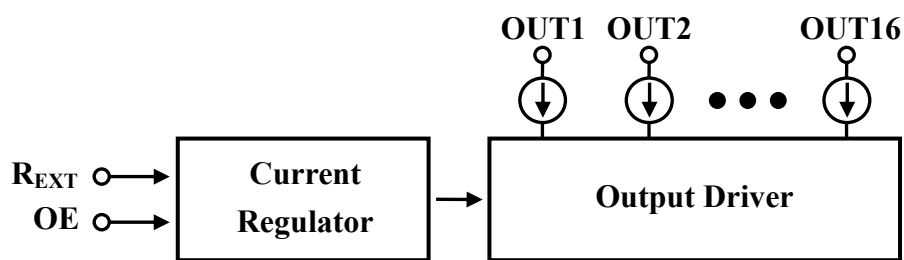
Pin Configuration



Terminal Description

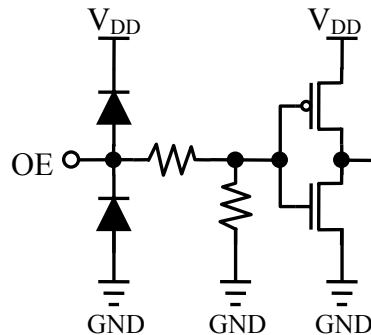
Pin No.	Pin Name	Function
1	GND	Ground terminal
2	OE	Input terminal of output enable signal. Output is enabled when OE is high.
3~18	OUT1~16	Output terminals with constant current
19	REXT	Input terminal connected to an external resistor for setting up all output current
20	VDD	Supply voltage terminal

Block Diagram



SCT2016S

Equivalent Circuits of Inputs



Ordering information

Part	Package	Unit per reel(pcs)
SCT2016STSG	Green TSSOP20(173mil) with thermal pad	2500

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Maximum Ratings (T_A = 25°C)

Characteristic	Symbol	Rating	Unit
Supply voltage	V _{DD}	7	V
Input voltage	V _{IN}	-0.2 ~ V _{DD} +0.2	V
Output current	I _{OUT}	60	mA/Channel
Output voltage	V _{OUT}	24	V
Total GND terminals current	I _{GND}	1000	mA
Power dissipation(Free Air)	TSSOP20 P _D	1.39	W
Thermal resistance(Free Air)	TSSOP20 R _{TH(j-a)}	90	°C /W
Operating temperature	T _{OPR}	-40~+85	°C
Storage temperature	T _{STG}	-55~+150	°C

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

Characteristic	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage	V_{DD}	-	3	-	5.5	V
Output voltage	V_{OUT}	Output OFF	-	-	24	V
		Output ON	-	1	4	V
Output current	I_{OUT}	$V_{DD}=3.3/5V$	5	-	30/45	mA
Input voltage	V_{IH}	-	$0.7V_{DD}$	-	V_{DD}	V
	V_{IL}	-	0	-	$0.3V_{DD}$	V
OE pulse width	t_w	-	200	-	-	ns

Electrical Characteristics ($V_{DD}=3.3/5V$, $T_A=25^\circ\text{C}$ unless otherwise noted)

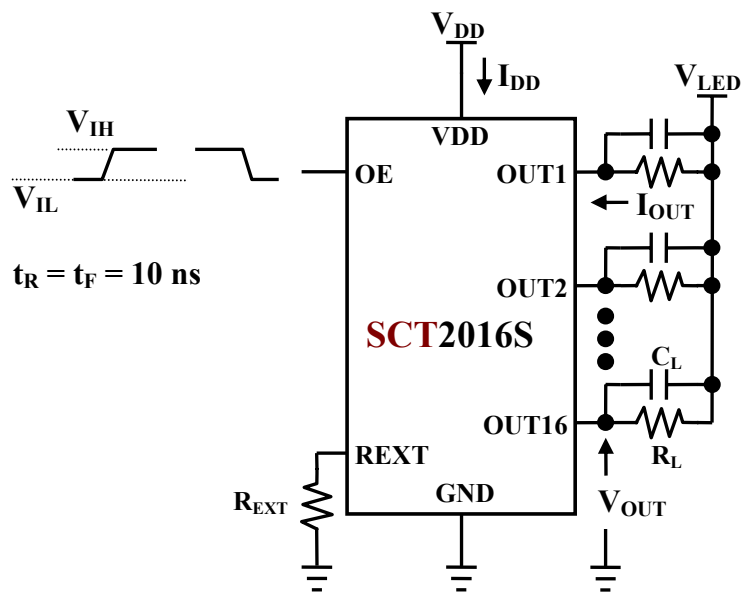
Characteristic	Symbol	Conditions	Min.	Typ.	Max.	Unit		
Input voltage	V_{IH}	-	$0.7V_{DD}$	-	V_{DD}	V		
	V_{IL}	-	0	-	$0.3V_{DD}$	V		
Output leakage current	I_{OL}	$V_{OUT} = 17V$	-	1	-	μA		
Output current	I_{OUT}	$V_{OUT}=1V$, $R_{EXT}=900\Omega$	-	21	-	mA		
Current channel skew*	dI_{OUT1}	$V_{OUT}=1V$, $R_{EXT}=900\Omega$	-	± 2	± 3	%		
Current chip skew	dI_{OUT2}	$V_{OUT}=1V$, $R_{EXT}=900\Omega$	-	± 4	± 6	%		
Line regulation I_{OUT} vs. V_{DD}	$\%/dV_{DD}$	$3V < V_{DD} < 5.5V$ $R_{EXT}=900\Omega$, $V_{OUT} > 1V$	-	-	± 1	$\%/V$		
Load regulation I_{OUT} vs. V_{OUT}	$\%/dV_{OUT}$	$1V < V_{OUT} < 4V$, $R_{EXT}=900\Omega$, $V_{DD}=3.3-5V$	-	-	± 1	$\%/V$		
Pull-down resistor	R_{DOWN}	OE	-	500	-	$\text{K}\Omega$		
Thermal shutdown	T_H	Junction Temperature	-	160	-	$^\circ\text{C}$		
	T_L		-	110	-	$^\circ\text{C}$		
Supply current	OFF	$I_{DD(OFF)1}$	$R_{EXT} = \text{Open}$, $OUT_1 \sim OUT_{16} = \text{OFF}$		-	3	5	mA
		$I_{DD(OFF)2}$	$R_{EXT} = 900\Omega$, $OUT_1 \sim OUT_{16} = \text{OFF}$		-	6	8	
	ON	$I_{DD(ON)}$	$R_{EXT} = 900\Omega$, $OUT_1 \sim OUT_{16} = \text{ON}$		-	8	10	

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

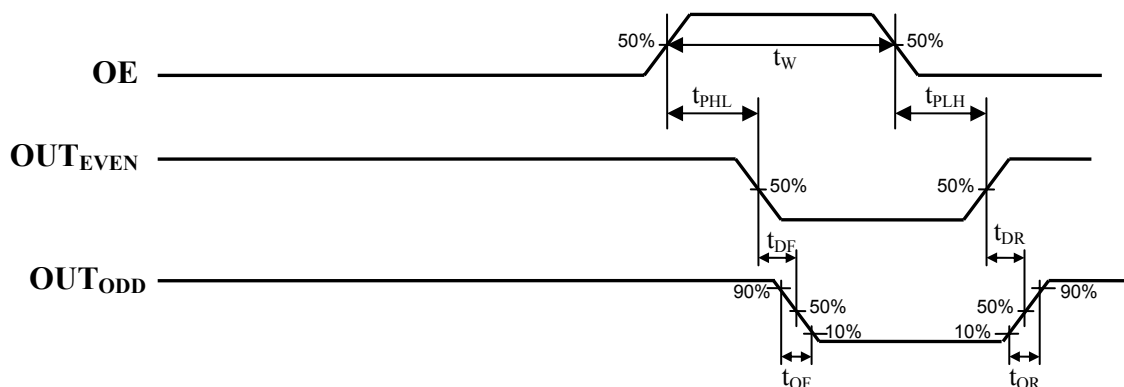
Switching Characteristics ($V_{DD}=3.3/5V$, $T_A=25^\circ C$ unless otherwise noted)

Characteristic		Symbol	Condition	Min.	Typ.	Max.	Unit
Propagation delay time ("L" to "H")	OE - OUTn	t_{PLH}	$V_{DD} = 3.3/5 V$ $V_{LED} = 5V$ $V_{IH} = V_{DD}$ $V_{IL} = GND$ $R_{EXT} = 900\Omega$ $R_L = 180\Omega$ $C_L = 10pF$	-	40	60	ns
Propagation delay time ("H" to "L")	OE - OUTn	t_{PHL}		-	40	60	ns
Pulse width	OE	t_w		200	-	-	ns
Output rise time of I_{OUT}		t_{OR}		-	40	60	ns
Output fall time of I_{OUT}		t_{OF}		-	40	60	ns
Output delay		t_{DR}		OUT _{ODD} to OUT _{EVEN}	-	30	-
		t_{DF}		-	30	-	ns

Test Circuit for Switching Characteristics

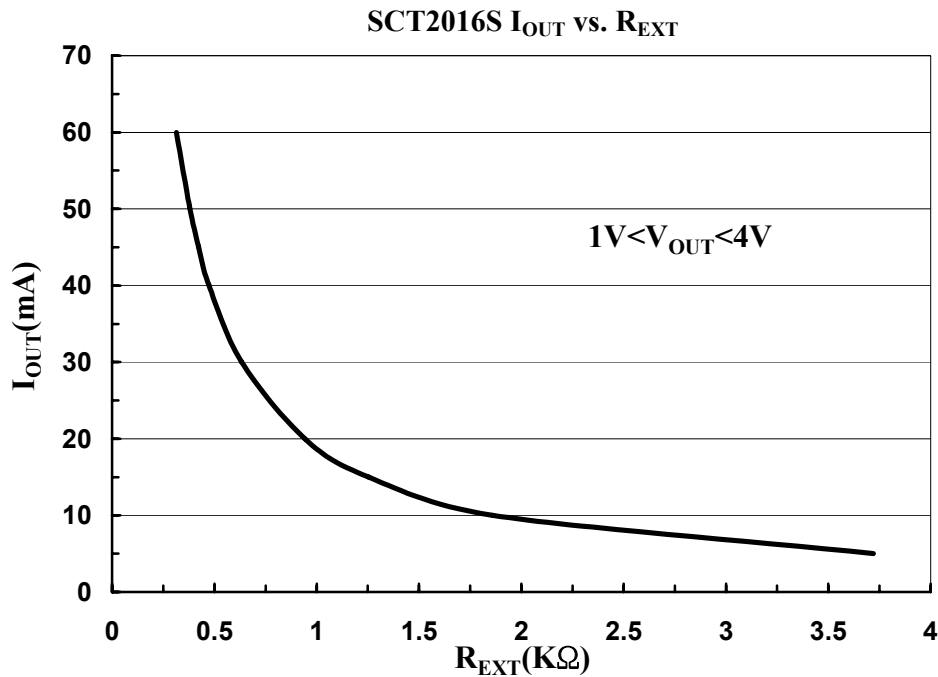


Timing Waveform



Adjusting Output Current

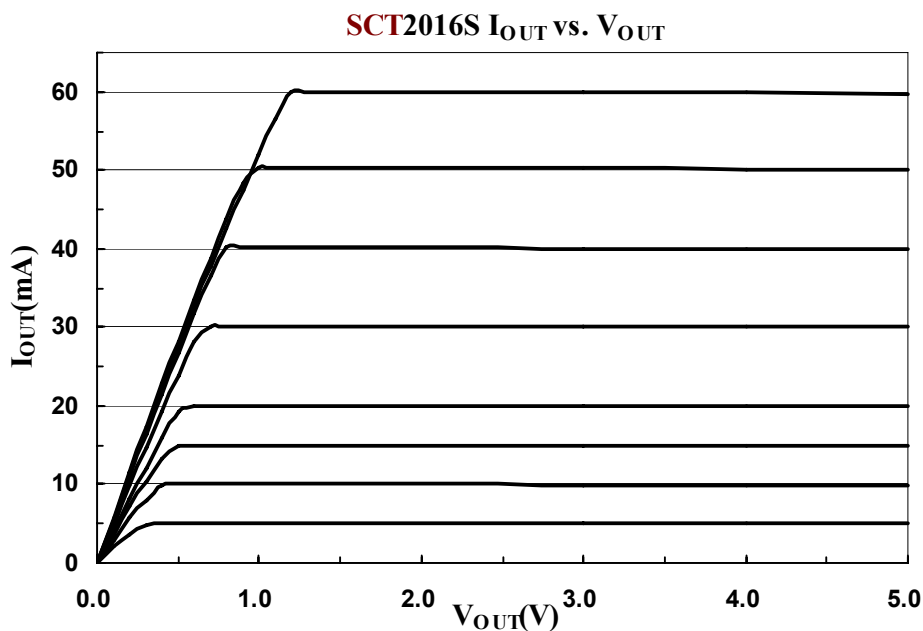
All SCT2016S's output currents (I_{OUT}) are set by one external resistor at pin REXT. The output current I_{OUT} versus resistance of R_{EXT} is shown as the following figure.



Furthermore, when SCT2016S's output voltage is set between 1 Volt and 4 Volt, the output current can be estimated approximately by: $I_{OUT} = 30(630 / R_{EXT})$ (mA) (chip skew < $\pm 6\%$). Thus the output currents are set about 21mA at $R_{EXT} = 900\Omega$.

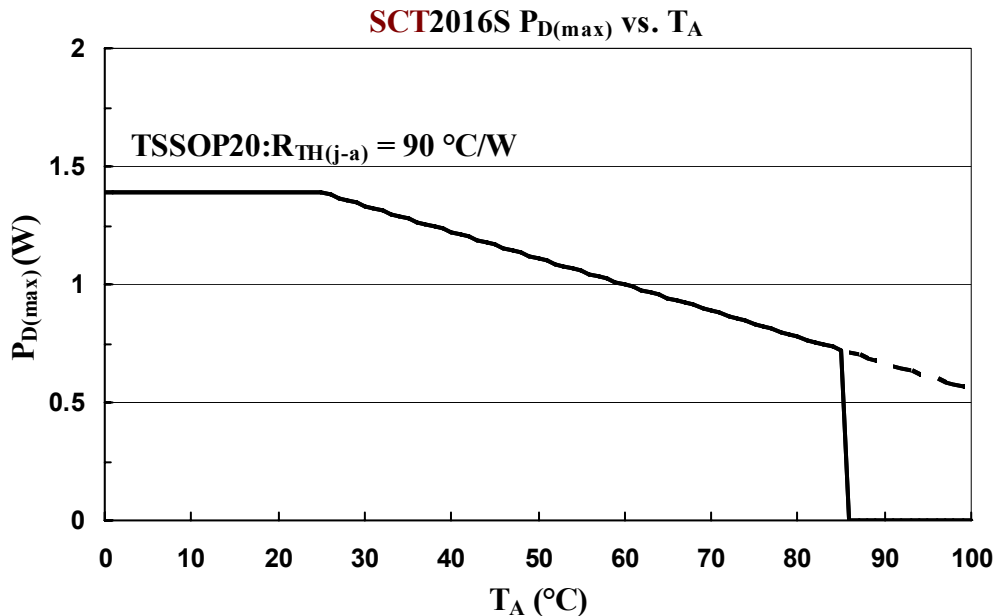
Output Characteristics

The current characteristic of output stage is flat. The output current can be kept constantly regardless of the variations of LED forward voltage when $V_{OUT} > 1V$. The relationship between I_{OUT} and V_{OUT} is shown below:



Maximum Power Dissipation

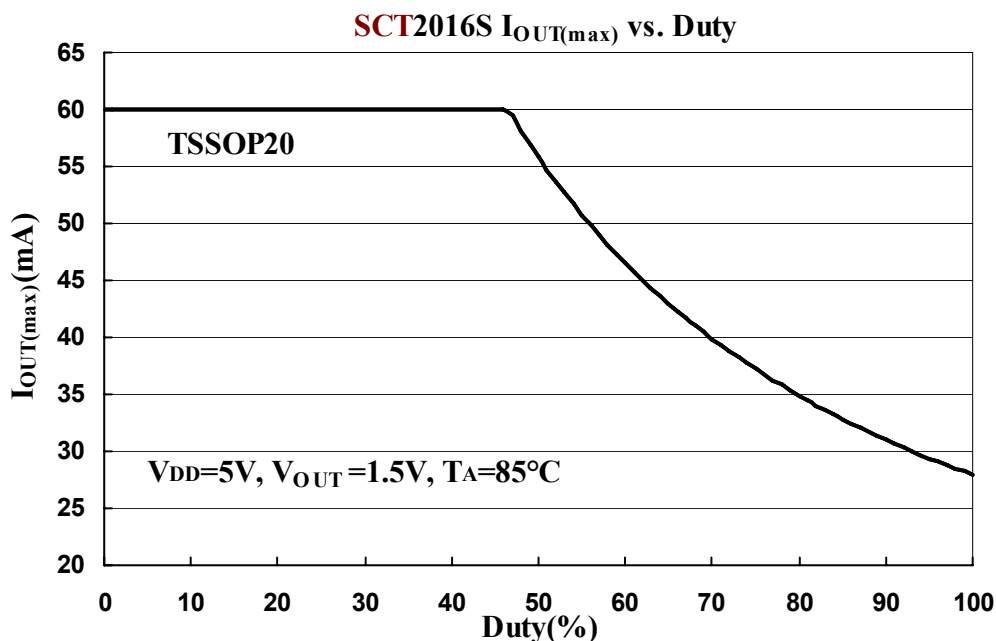
The maximum power dissipation ($P_{D(max)}$) of a semiconductor chip varied to different package and ambient temperature. It's determined as $P_{D(max)}=(T_{J(max)} - T_A)/R_{TH(j-a)}$ where $T_{J(max)}$: maximum chip junction temperature usually considered as 150°C, T_A : ambient temperature, $R_{TH(j-a)}$: thermal resistance. Since $P=IV$, for sink larger I_{OUT} , users had better to add proper voltage reducers on output to reduce the heat generated from the SCT2016S.



Limitation on Maximum Output Current

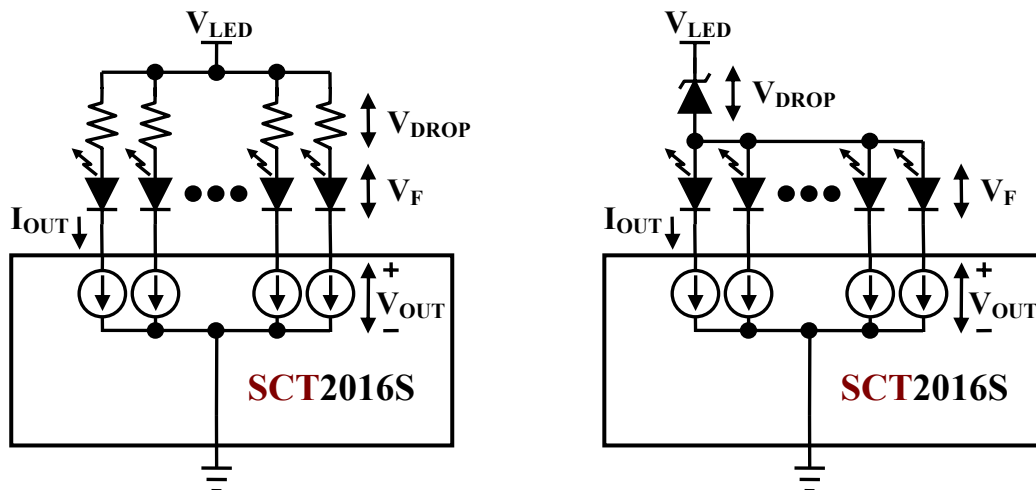
The maximum output current vs. duty cycle is estimated by:

$$I_{OUT(max)} = (((T_{J(max)} - T_A) / R_{TH(j-a)}) - (V_{DD} * I_{DD})) / V_{OUT} / \text{Duty} / N, \text{ where } T_{J(max)} = 150^\circ\text{C}, N = 16 (\text{all ON})$$



Load Supply Voltage (V_{LED})

The SCT2016S can be operated very well when V_{OUT} ranging from 1V to 4V. It is recommended to use the lowest possible supply voltage or set a voltage reducer to reduce the V_{OUT} voltage, at the same time reduce the power dissipation of the SCT2016S. The diagram instructions shown below are to lower down the output voltage. This can be done by adding additional resistor or zener diode, thus $V_{OUT} = V_{LED} - V_{DROP} - V_F$.

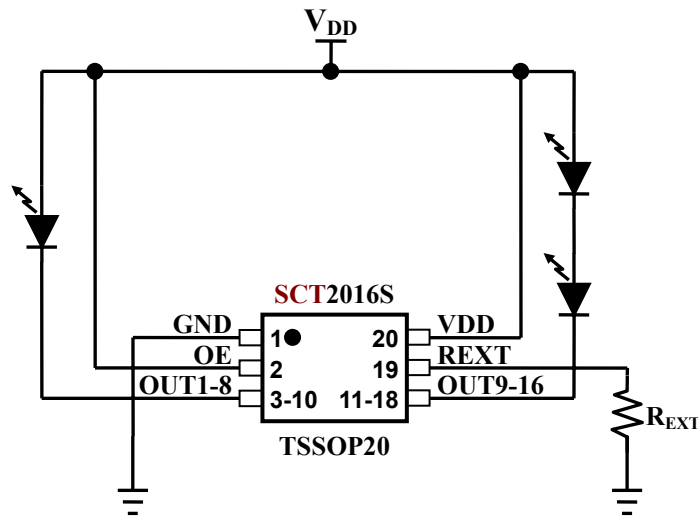


Over Temperature Shutdown

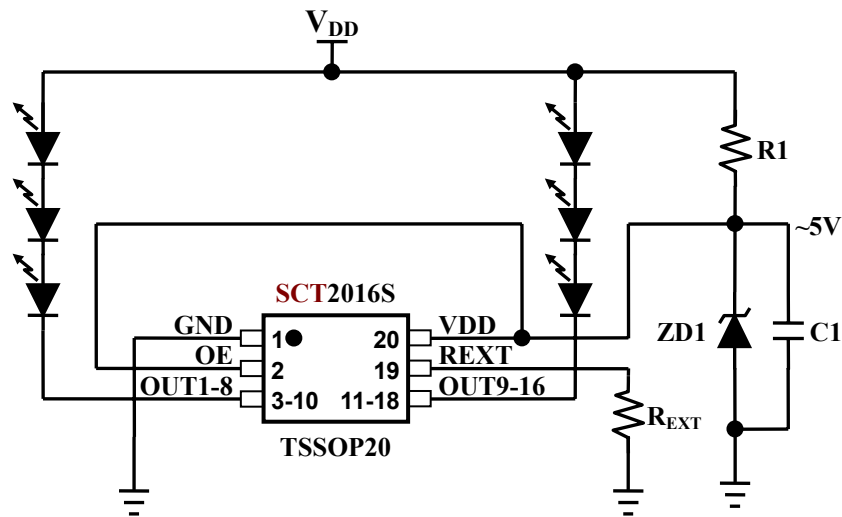
The SCT2016S contains thermal shutdown scheme to prevent damage from over heated. The internal thermal sensor turns off all outputs when the die temperature exceeds $\sim +160^{\circ}\text{C}$. The outputs are enabled again when the die temperature drops below $\sim +110^{\circ}\text{C}$.

Typical Application Circuits

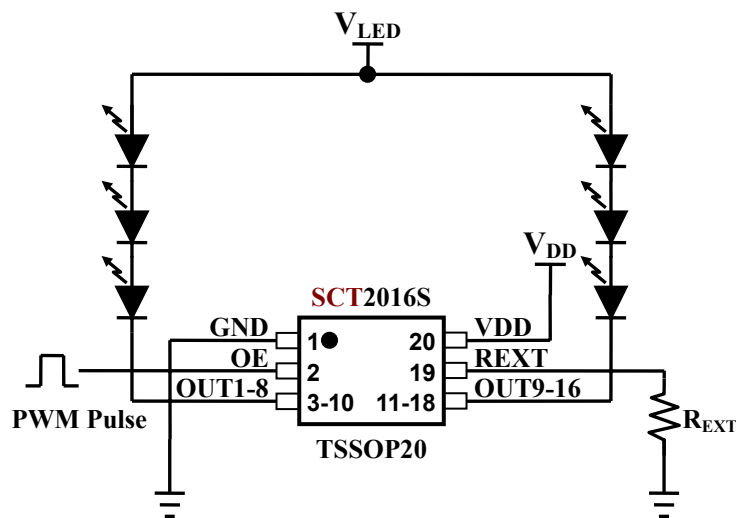
(1) Lighting with recommended $V_{DD}=3.3/5V$



(2) Lighting with $V_{DD} > 5V$, e.g. $V_{DD}=12V/24V$



(3) Lighting with dimming control

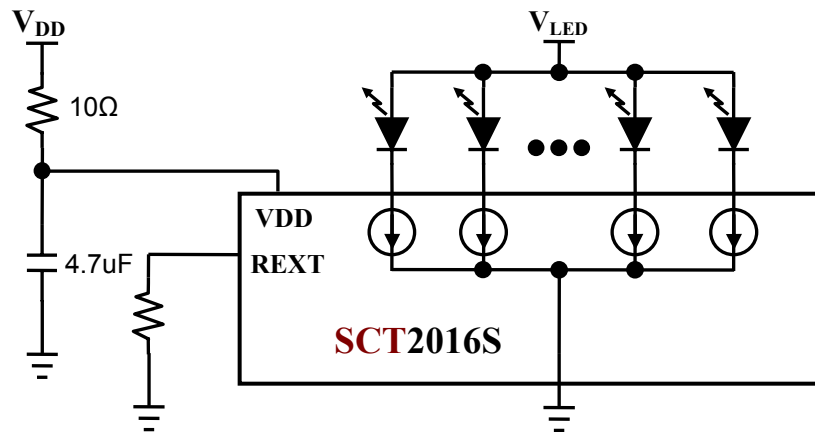


PCB Design Considerations

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

Decoupling Capacitor

Place a decoupling capacitor e.g. 4.7uF between V_{DD} and GND pins of the SCT2016S. Locate the capacitor as close to the SCT2016S as possible. The necessary capacitance depends on the LED load current and dimming frequency.



External Resistor (R_{EXT})

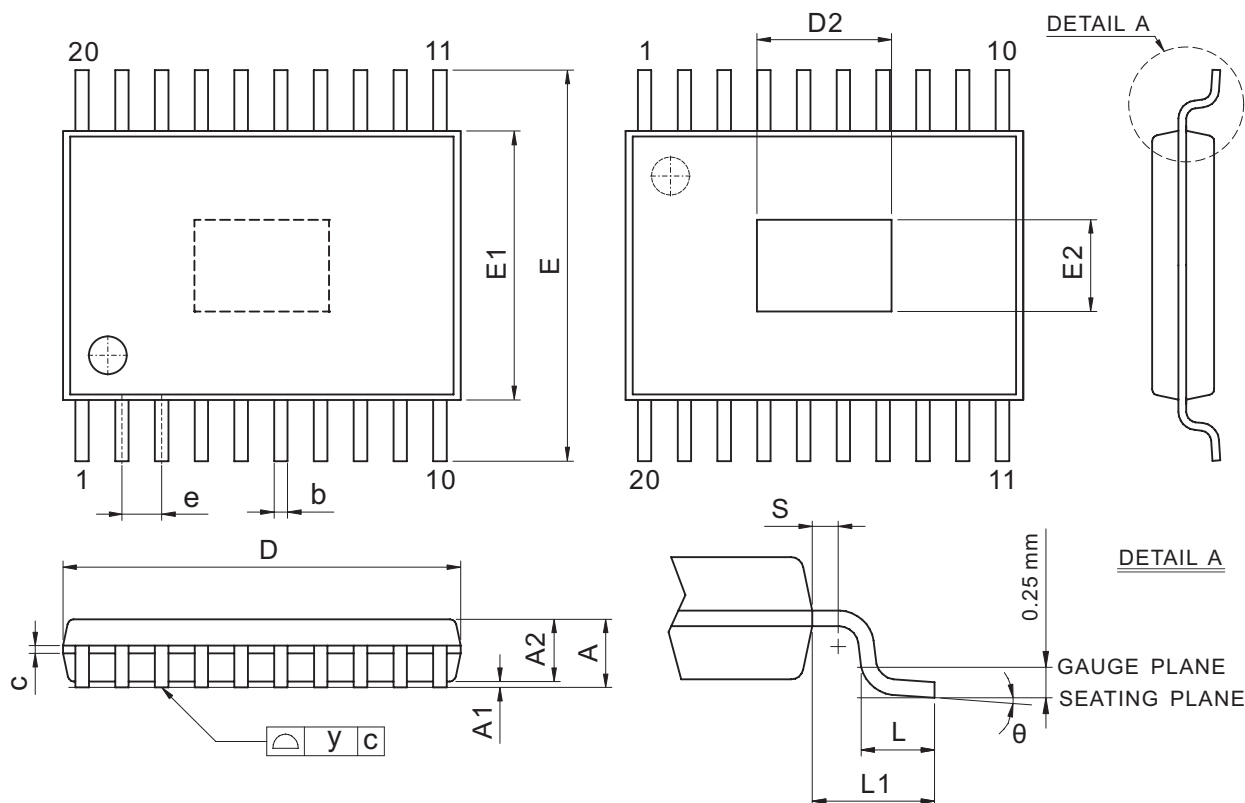
Locate the external resistor as close to the REXT pin in as possible to avoid noise.

Power and Ground

Maximizing the width and minimizing the length of V_{DD} and GND trace improve efficiency and lower ground bouncing by reducing both power and ground parasitic resistance and inductance. A small value of resistor e.g. 10Ω series in power input of the SCT2016S in conjunction with decoupling capacitor shunting the ICs is recommended. Separating and feeding the LED power from another stable supply terminal V_{LED} is strongly recommended.

Package Dimension

TSSOP20TP([check up-to-date version](#))



Symbol	Dimension (mm)			Dimension (mil)		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.20	-	-	47.2
A1	0.05	-	0.15	2.0	-	6.0
A2	0.80	0.90	1.05	31.0	35.0	41.0
b	0.19	-	0.30	7.0	-	12.0
c	0.09	-	0.20	4.0	-	8.0
D	6.40	6.50	6.60	252.0	255.9	259.8
E1	4.30	4.40	4.50	169.0	173.0	177.0
E	6.40 BSC			252.0 BSC		
e	0.65 BSC			26.0 BSC		
L1	1.00 REF			39.0 REF		
L	0.45	0.60	0.75	18.0	24.0	30.0
y	-	-	0.10	-	-	4.0
θ	0°	-	8°	0°	-	8°
D2	-	3.81	-	-	150.0	-
E2	-	3.00	-	-	118.1	-

Revision History ([check up-to-date version](#))

Data Sheet Version	Remark
V01_02	P7,11 updated

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