



# SCT2130

## REVISION HISTORY

Revision 1.0: Release to production.

Revision 1.1: Update the accuracy range of  $V_{FB}$ .

Revision 1.2: Update the upper limits for  $I_Q$ ,  $I_{SD}$ ,  $R_{HS}$ , and  $R_{LS}$ .

## DEVICE ORDER INFORMATION

PART NUMBER	PACKAGE MARKING	PACKAGE DISCRIPTION
SCT2130FTA	2130	QFN-8L1.5mm*2mm

1) For Tape & Reel, Add Suffix R (e.g. SCT2130FTAR)

## ABSOLUTE MAXIMUM RATINGS

Over operating free-air temperature unless otherwise noted <sup>(1)</sup>

DESCRIPTION	MIN	MAX	UNIT
VIN, EN, PG, SW, VOUT	-0.3	7	V
SS, FB	-0.3	5.5	V
Operating junction temperature $T_J^{(2)}$	-40	150	C
Storage temperature $T_{STG}$	-65	150	C

## PIN CONFIGURATION

PG	VOUT
SW	SS
GND	EN
PG	

Top View: QFN-8L 1.5mm x 2mm, Plastic

(1)

(2)

## PIN FUNCTIONS

Pin	Pin	Function	
1	5	2A	5
PG	1		
VIN	2		
SW	3	Switch output. SW is driven up to VIN through the high-side power MOSFET during on-time. The inductor current drives SW to negative voltage through low-side power MOSFET during off-time.	
GND	4		
EN	5	Enable logic input.	

SS



# SCT2130

## ELECTRICAL CHARACTERISTICS

$V_{IN}=5V$ ,  $T_J=-40^{\circ}C\sim 125^{\circ}C$ , typical values are tested under  $25^{\circ}C$ .

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
<b>Power Supply and Output</b>						
$V_{IN}$	Operating input voltage		2.8		6	V
$V_{IN\_UVLO}$	Input UVLO	$V_{IN}$ rising		2.7		V
	Hysteresis			175		mV
$I_{SD}$	Shutdown current			0.7	3	$\mu A$
$I_Q$	Quiescent current from $V_{IN}$	no load, no switching		1000	1400	$\mu A$
$V_{FB}$	Reference voltage of FB	$T_J=25^{\circ}C$	0.593	0.6	0.607	V
$I_{FB}$	FB pin leakage current				100	nA
$V_{UVP}$	Undervoltage protection of reference voltage			433		mV
<b>Power switch</b>						
$R_{HS}$	High-side switch on resistance			25	48	m
$R_{LS}$	Low-side switch on resistance			20	38	m
$I_{LIM_{HS}}$	High-side peak current limit		3.8	4.5	5.2	A

## TYPICAL CHARACTERISTICS



Figure 1. Efficiency vs Load Current, Vout=1.2V

Figure 2. Efficiency vs Load Current, Vout=1.8V

Figure 3. Line Regulation, Io=1.5A

Figure 4. Load Regulation, Vin=5V

Figure 5.  $V_{FB}$  vs Temperature

Figure 6. UVLO vs Temperature

## FUNCTIONAL BLOCK DIAGRAM

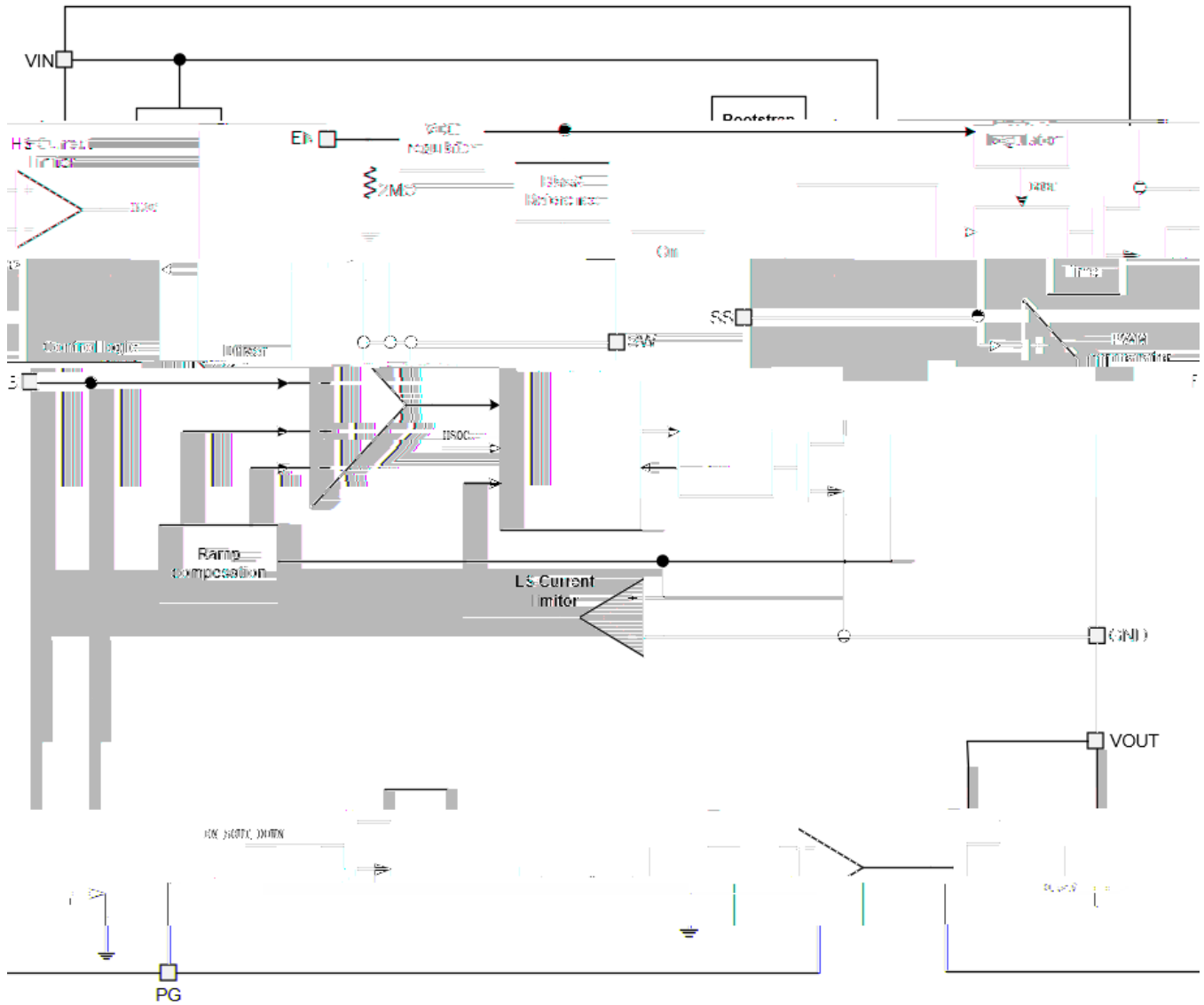


Figure 7. Functional Block Diagram

## OPERATION

### Overview

The SCT2130 is a 2.8V, 3A output synchronous buck converter with a 25mV ripple and 20mΩ R<sub>DS(on)</sub> low-side power MOSFETs. It implements constant on time control to regulate output voltage, providing excellent line and load regulation.

# SCT2130

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When the device is disabled, the part automatically goes into output discharge mode, and its internal discharge MOSFET in VOUT pin provides a discharge path for the output capacitor.

## Output Voltage

The SCT2130 regulates the internal reference voltage at 0.6V. The output voltage is set by a resistor divider from the output node to the FB pin. It is recommended to use 1% tolerance or better resistors. Use Equation 2 to calculate resistance of resistor dividers. To improve efficiency at light loads, larger value resistors are recommended. However, if the values are too high, the regulator will be more susceptible to noise affecting output voltage accuracy.

$$\text{---} \tag{2}$$

Where:

- $R_{FB\_TOP}$  is the resistor connecting the output to the FB pin.
- $R_{FB\_BOT}$  is the resistor connecting the FB pin to the ground.

## Soft Start (SS)

The SCT2130 has an external soft start (SS) pin that ramps up the output voltage at a controlled slew rate to avoid capacitor.  $t_{ss}$  can be calculated with Equation 3:

$$\text{---} \tag{3}$$

Where:

- $C_{ss}$  is the external SS capacitor.
- $I_{ss}$

The minimum SS capacitor is recommended to be 1nF.

## Over Current Protection (OCP) and Hiccup Mode

In each switching cycle, the inductor current is sensed by monitoring the high-side MOSFET during the ON period and the low-side MOSFET during the OFF period. When the inductor current ( $I_L$ ) reaches the high-side MOSFET peak current limit (typically 4.5A) during the ON period, the high-side MOSFET is forced off immediately to prevent the current from rising further. Then the low-side MOSFET turns on, and stays on until  $I_L$  drops below the low-side MOSFET valley current limit (typically 3.5A). If output loading continues to increase, output will drop below the  $V_{UVP}$ , and SS pin is discharged such that output is 0V. Then the device will count for 7 cycles of soft-start time for hiccup -start period. If overload or hard short condition still exists during soft-start and make FB voltage lower than  $V_{UVP}$ , the device enters into turning-off mode again. When overload or hard short condition is removed, the device automatically recovers to enters normal regulating operation.

## Power Good Indicator

The SCT2130 has one power good (PG) output to indicate normal operation after the soft-start time. PG is the open drain of an internal MOSFET, which has a maximum  $R_{DS(ON)}$  below 2  $\Omega$  IN or an external voltage source through an external a resistor (e.g., turns on, and PG is pulled to GND before soft start is ready. After  $V_{FB}$  reaches 95% of  $V_{REF}$ , PG is pulled high by the external voltage source with 80us delay. When  $V_{FB}$  drops to 90% or rises to 110% of  $V_{REF}$ , the PG voltage is



pulled to GND to indicate an output failure. If VIN and EN are not available, and PG is pulled up by an external power supply, PG will self-  
-up resistor is used, the voltage on the pin is below 0.4V.

## Thermal Shutdown

Once the junction temperature in the SCT2130 exceeds 160°C, the thermal sensing circuit stops converter switching and restarts with the junction temperature falling below 140°C. Thermal shutdown prevents the damage on device during excessive heat and power dissipation condition.



### Output Voltage

The output voltage is set by an external resistor divider R1 and R2 in typical application schematic. Recommended R2 resistance is 10.2K . Use Equation 4 to calculate R1.

Table 1. R<sub>1</sub>, R<sub>2</sub> Value for Common Output Voltage (Room Temperature)

V <sub>OUT</sub>	R <sub>1</sub>	R <sub>2</sub>
1.2 V	10.2	10.2
1.8 V	20	10.2
3.3 V	46.5	10.2

$$\text{---} \quad (4)$$

where:

- V<sub>REF</sub> is the feedback reference voltage, typical 0.6V

### Inductor Selection

There are several factors should be considered in selecting inductor such as inductance, saturation current, the RMS current and DC resistance (DCR). Larger inductance results in less inductor current ripple and therefore leads to lower output voltage ripple. However, the larger value inductor always corresponds to a bigger physical size, higher series resistance, and lower saturation current. A good rule for determining the inductance to use is to allow the inductor peak-to-peak ripple current to be approximately 10%~40% of the maximum output current.

The peak-to-peak ripple current in the inductor I<sub>LPP</sub> can be calculated as in Equation 5.

$$\text{---} \quad (5)$$

Where:

- I<sub>LPP</sub> is the inductor peak-to-peak current.
- L is the inductance of inductor.
- f<sub>sw</sub> is the switching frequency.
- V<sub>OUT</sub> is the output voltage.
- V<sub>IN</sub> is the input voltage.

Since the inductor-current ripple increases with the input voltage, so the maximum input voltage in application is always used to calculate the minimum inductance required. Use Equation 6 to calculate the inductance value.

$$\text{---} \quad (6)$$

Where

- L<sub>MIN</sub> is the minimum inductance required.
- f<sub>sw</sub> is the switching frequency.
- V<sub>OUT</sub> is the output voltage.
- V<sub>IN(max)</sub> is the maximum input voltage.
- I<sub>OUT(max)</sub> is the maximum DC load current.
- LIR is coefficient of I<sub>LPP</sub> to I<sub>OUT</sub>.

The total current flowing through the inductor is the inductor ripple current plus the output current. When selecting an inductor, choose its rated current especially the saturation current larger than its peak operation current and RMS current also not be exceeded. Therefore, the peak switching current of inductor, I<sub>LPEAK</sub> and I<sub>LRMS</sub> can be calculated as in Equation 7 and Equation 8.



**Output Capacitor Selection**

The selection of output capacitor will affect output voltage ripple in steady state and load transient performance.

The output ripple is essentially composed of two parts. One is caused by the inductor current ripple going through the Equivalent Series Resistance ESR of the output capacitors and the other is caused by the inductor current ripple charging and discharging the output capacitors. To achieve small output voltage ripple, choose a low-ESR output capacitor like ceramic capacitor. For ceramic capacitors, the capacitance dominates the output ripple. For simplification, the output voltage ripple can be estimated by Equation 12 desired.

$$\Delta V_{OUT} = \frac{V_{OUT}}{f_{SW}} \sqrt{\frac{L}{C_{OUT}}} \quad (12)$$

Where:

- $\Delta V_{OUT}$  is the output voltage ripple.
- $f_{SW}$  is the switching frequency.
- $L$  is the inductance of inductor.
- $C_{OUT}$  is the output capacitance.
- $V_{OUT}$  is the output voltage.
- $V_{IN}$  is the input voltage.

Due to  $\Delta V_{OUT}$  degrading under DC bias, the bias voltage can significantly reduce capacitance. Ceramic capacitors can lose most of their capacitance at rated voltage. Therefore, leave margin on the voltage rating to ensure adequate effective capacitance. Typically, two

# SCT2130

## Application Waveforms

$V_{IN}=5V$ ,  $V_{OUT}=1.2V$ , unless otherwise noted

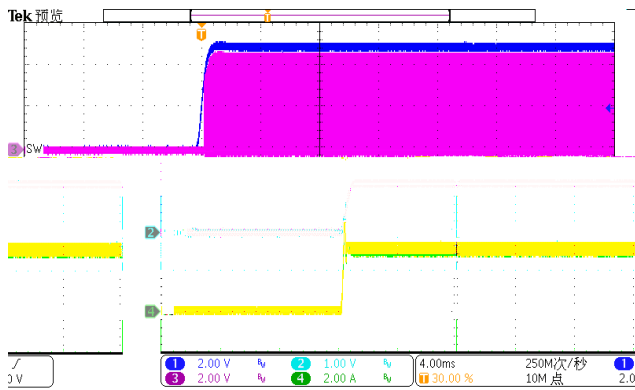


Figure 9. Power up ( $I_{LOAD}=3A$ )

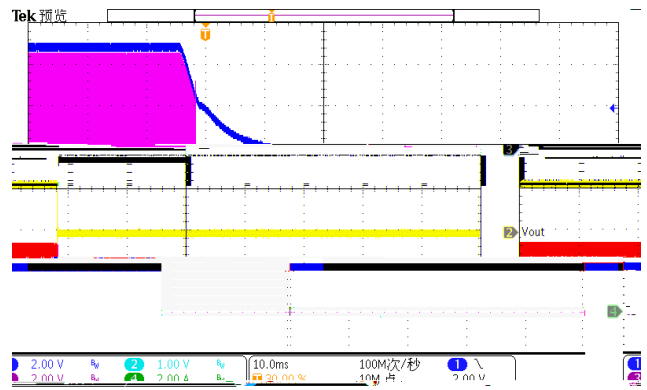


Figure 10. Power down ( $I_{LOAD}=3A$ )

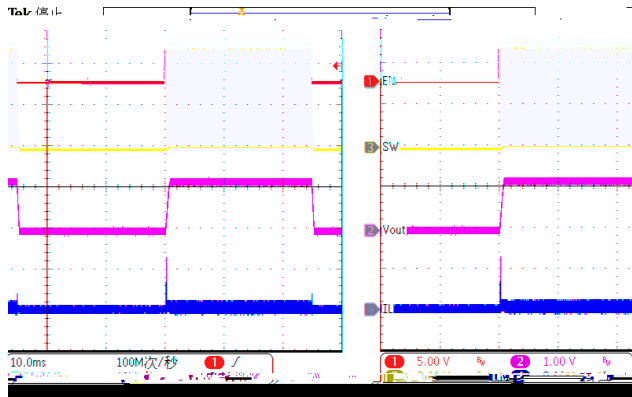


Figure 11. EN toggle ( $I_{LOAD}=0.1A$ )

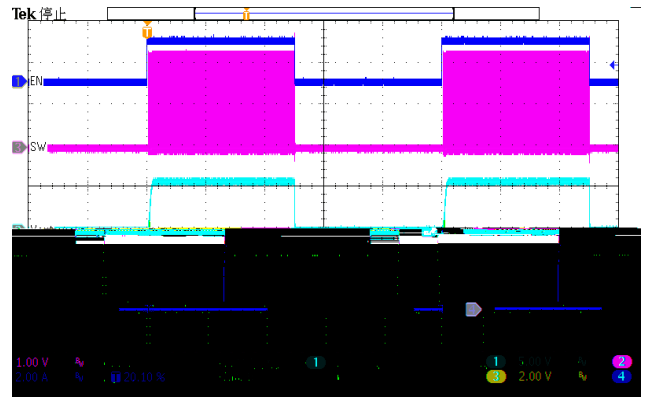


Figure 12. EN toggle ( $I_{LOAD}=3A$ )

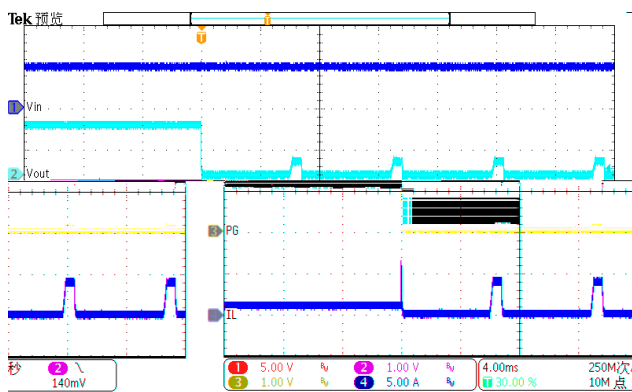


Figure 13. Over Current Protection (1A to hard short)

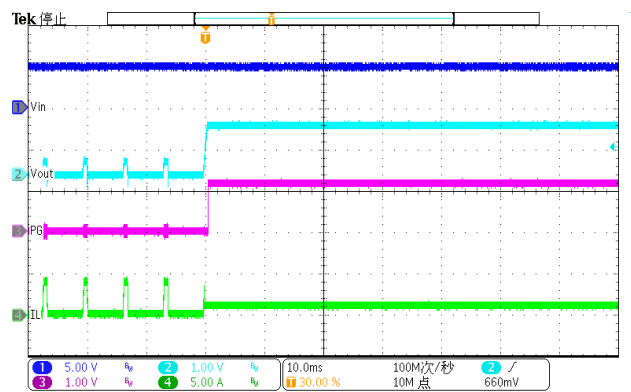


Figure 14. Over Current Release (hard short to 1A)

Application Waveforms

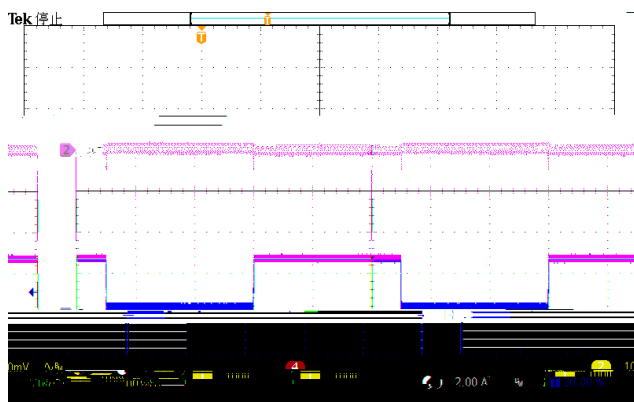


Figure 15. Load Transient (0.3A-2.7A, 1.6A/us)

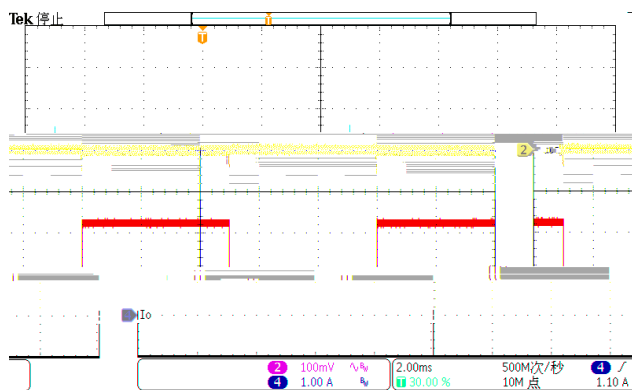


Figure 16. Load Transient (0.75A-2.25A, 1.6A/us)

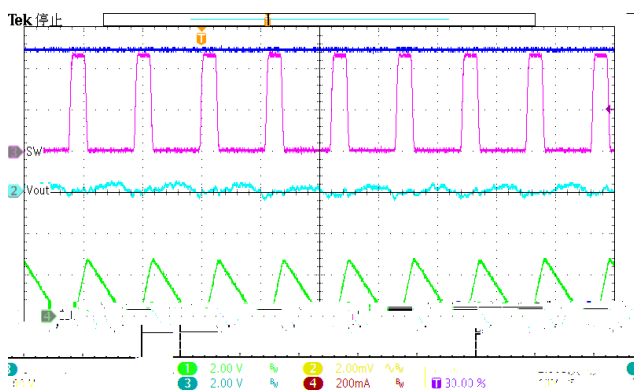


Figure 17. Output Ripple ( $I_{LOAD}=100mA$ )

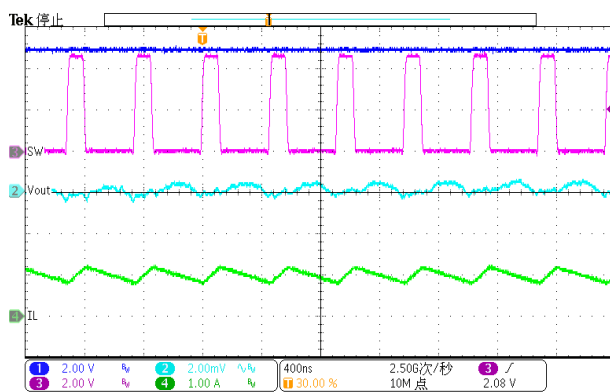


Figure 18. Output Ripple ( $I_{LOAD}=1A$ )

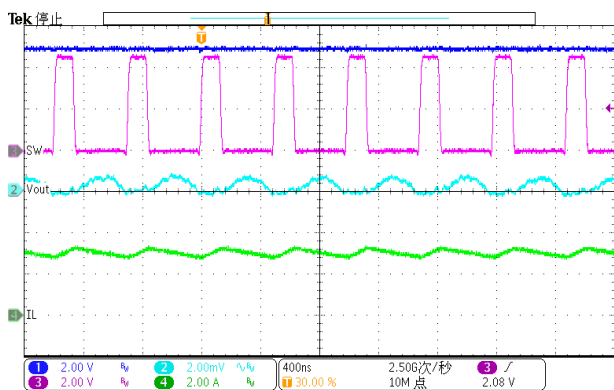


Figure 19. Output Ripple ( $I_{LOAD}=3A$ )



Figure 20. Thermal,  $V_{IN}=5V$ ,  $V_{OUT}=1.2V$ ,  $I_{LOAD}=3A$



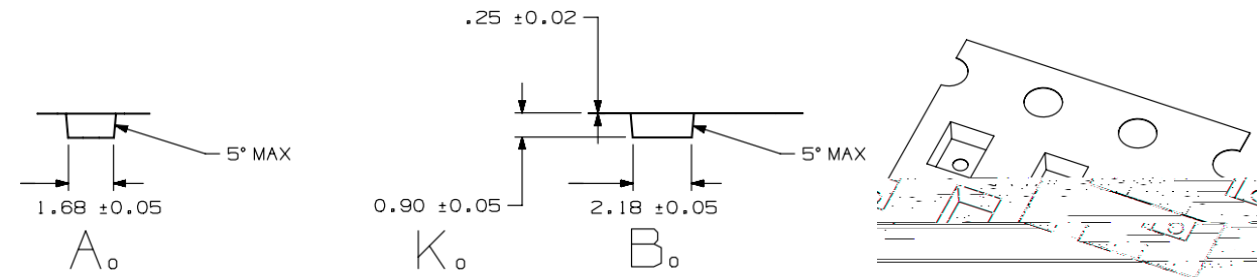
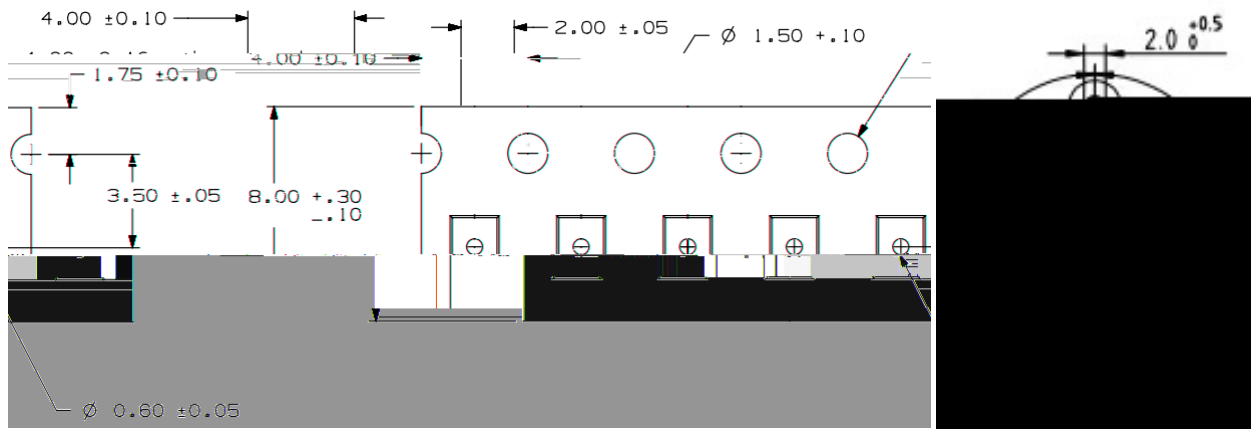
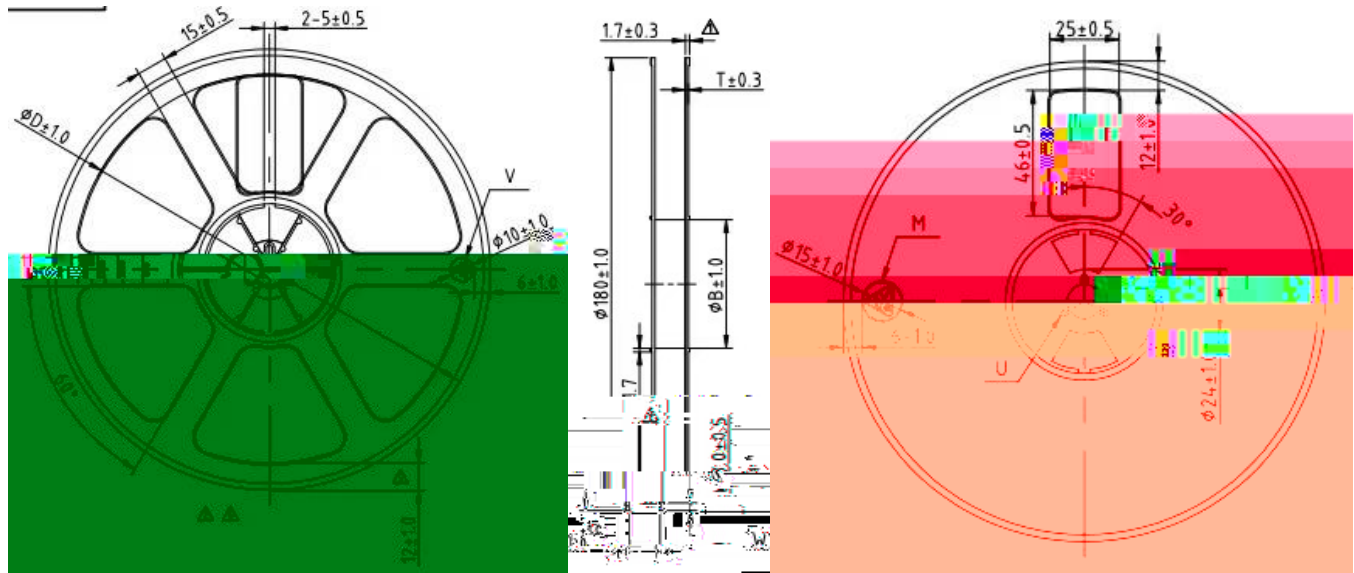




# SCT2130

## TAPE AND REEL INFORMATION

Orderable Device	Package Type	Pins	SPQ
SCT2130FTAR	QFN 1.5mmx2mm	8	3000



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