2.8V-6V Vin 3A Synchronous Step Down Convertor

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The SCT2131 is a monolithic, step-down switch-mode converter with built-in internal 25 -Side and 20 -Side Power MOSFETs. The device achieves 3A of continuous output current from a 2.8V to 6V input voltage range, with excellent load and line regulation. The output voltage can be regulated to as low as 0.6V.

The SCT2131, adopting the constant-on time (COT) mode control provides fast transient response and eases loop stabilization, greatly simplifies the converter off-chip configuration.

The SCT2131 features programmable soft-start time to avoid large inrush current and output voltage overshoot during startup. The SCT2131 operates in Pulse Frequency Modulation (PFM) to improve low light load efficiency. The switching frequency is fixed 2.1MHz.

It includes full protection features, such as cycle-by-cycle current limit and hiccup over current protection, output under-voltage protection, input under-voltage lockout.

The SCT2131 requires a minimal number of external components and is available in a space-saving QFN-8L 1.5mm*2mm package with Wettable Flank.

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- Automotive Infotainment
- Battery-Powered Devices
- Solid state driver
- Automotive Infotainment

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Revision 0.8: Customer sample.

Revision 0.81: Update Quiescent current.

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PART NUMBER	PACKAGE MARKING	PACKAGE DISCRIPTION
SCT2131FTA	2131	QFN-8L1.5mm*2mm

1) For Tape & Reel, Add Suffix R (e.g., SCT2131FTAR)

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Over operating free-air temperature unless otherwise noted (1)

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

(1)

(2)

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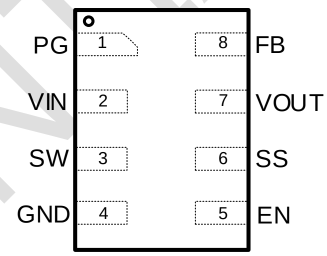

Top View: QFN-8L 1.5mm x 2mm, Plastic

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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	6	
VOUT	7	
FB	8	

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Over operating free-air temperature range unless otherwise noted.

PARAMETER	DEFINITION	MIN	MAX	UNIT
V_{IN}	Input voltage range	2.8	6	V
V_{OUT}	Output voltage range	0.6	5	V
T_J	[redacted]	-40	125	°C

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PARAMETER

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V_{IN}=5V, T_J=-40°C~125°C, typical values are tested under 25°C.

SYMBOL	PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
Power Supply and Output						
V_{IN}	Operating input voltage		2.8		6	V
V_{IN_UVLO}	Input UVLO Hysteresis	V_{IN} rising		2.7 175		V mV
I_{SD}	Shutdown current			0.7	3	uA
I_Q	Quiescent current from VIN	no load, no switching		65	80	uA
V_{FB}	Reference voltage of FB	Tj=25 °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
Power switch						
R_{HS}	High-side switch on resistance			25	48	m
R_{LS}	Low-side switch on resistance					

[redacted]

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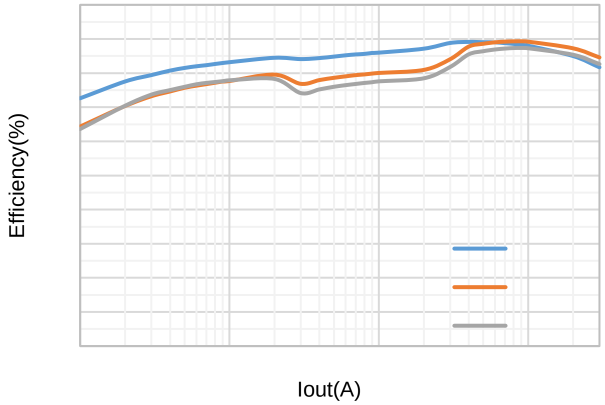

Figure 1. Efficiency vs Load Current, Vout=1.2V

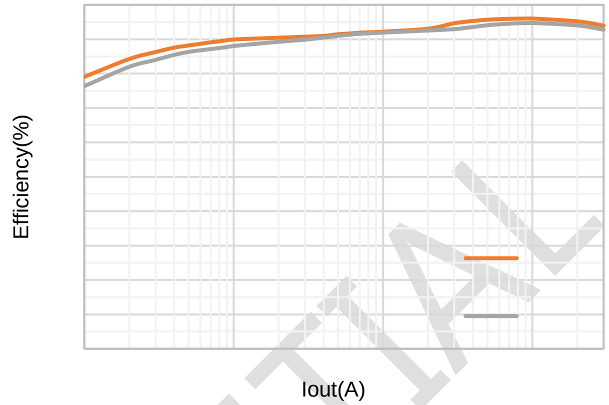

Figure 2. Efficiency vs Load Current, Vout=3.3V

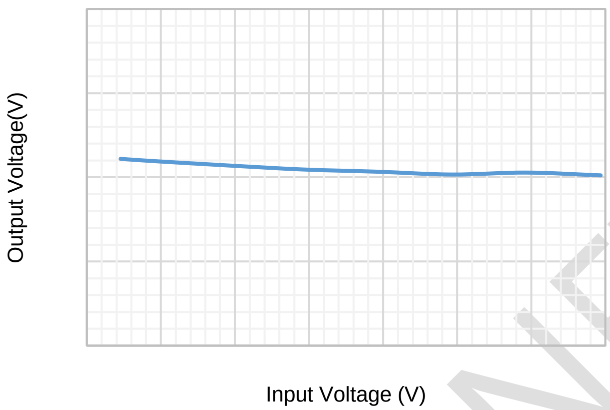

Figure 3. Line Regulation, Io=1.5A

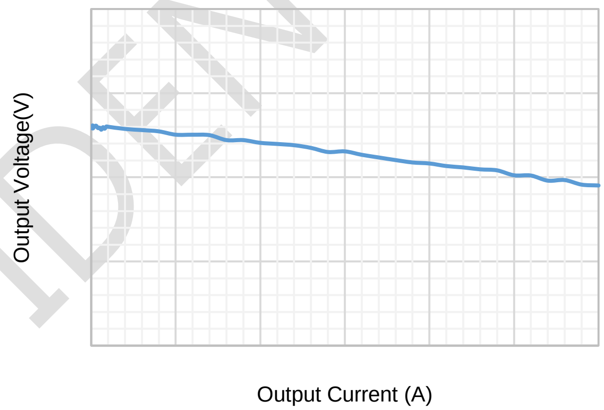

Figure 4. Load Regulation, Vin=5V

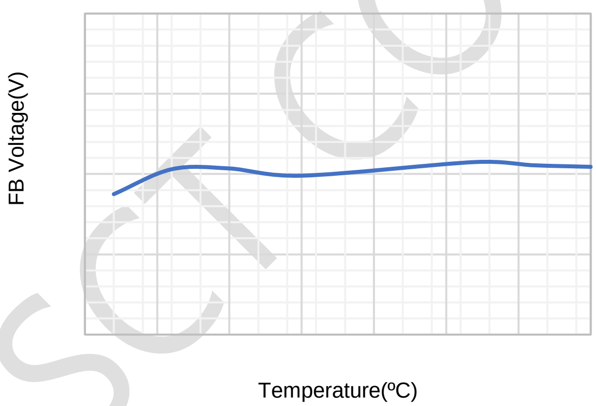

Figure 5. V_{FB} vs Temperature

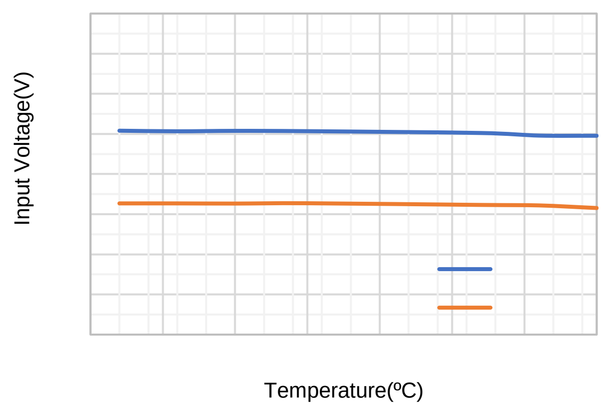

Figure 6. UVLO vs Temperature

When the device is disabled, the part automatically goes into output discharge mode, and its internal discharge MOSFET

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Typical Application

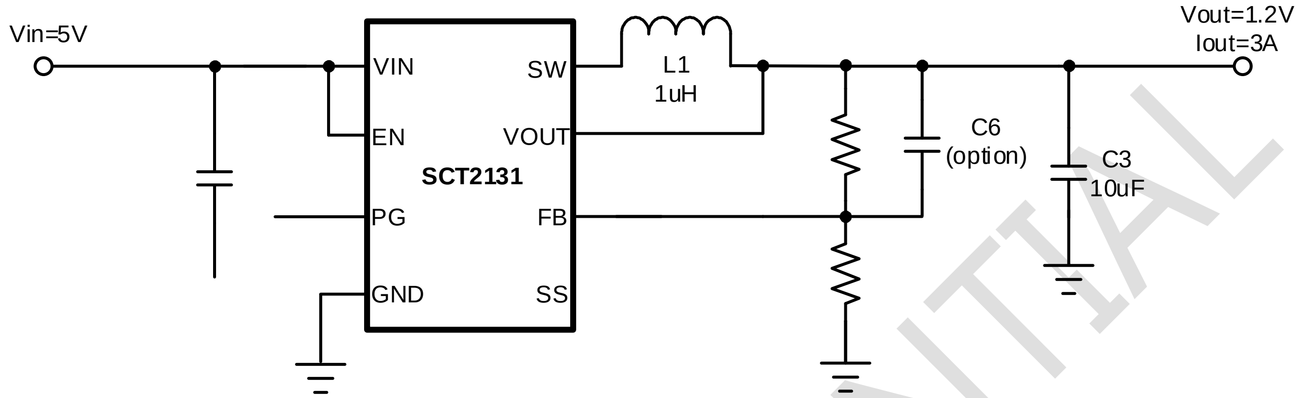

Figure 8. SCT2131 Design Example, 1.2V Output

Design Parameters

Design Parameters	Example Value
Input Voltage	5V Normal 2.8V to 6V
Output Voltage	1.2V
Maximum Output Current	3A
Switching Frequency	2.1MHz
Output voltage ripple (peak to peak)	2mV
Transient Response 0.3A to 2.7A load step	Vout =140mV

(7)

(8)

Where:

- I_{LPEAK} is the inductor peak current.
- I_{OUT} is the DC load current.
- I_{LPP} is the inductor peak-to-peak current.
- I_{LRMS} is the inductor RMS current.

In overloading or load transient conditions, the inductor peak current can increase up to the switch current limit of the device which is typically 4.5A. The most conservative approach is to choose an inductor with a saturation current rating greater than 4.5A. Because of the maximum I_{LPEAK} limited by device, the maximum output current that the SCT2131 can deliver also depends on the inductor current ripple. Thus, the maximum desired output current also affects the selection of inductance. The smaller inductor results in larger inductor current ripple leading to a lower maximum output current.

Input Capacitor Selection

The input current to the step-down DCDC converter is discontinuous, therefore it requires a capacitor to supply the AC current to the step-down DCDC converter while maintaining the DC input voltage. Use capacitors with low ESR for better performance. Ceramic capacitors with X5R or X7R dielectrics are usually suggested because of their low ESR and small temperature coefficients, and it is strongly recommended to use another lower value capacitor (e.g. 0.1uF) with small package size (0603) to filter high frequency switching noise. Place the small size capacitor as close to VIN and GND pins as possible.

The voltage rating of the input capacitor must be greater than the maximum input voltage. And the capacitor must also have a ripple current rating greater than the maximum input current ripple. The RMS current in the input capacitor can be calculated using Equation 9.

(9)

The worst case condition occurs at $V_{IN}=2*V_{OUT}$, where:

(10)

For simplification, choose an input capacitor with an RMS current rating greater than half of the maximum load current.

When selecting ceramic capacitors, it needs to consider the effective value of a capacitor decreasing as the DC bias voltage across a capacitor increasing.

The input capacitance value determines the input ripple voltage of the regulator. The input voltage ripple can be calculated using Equation 11 and the maximum input voltage ripple occurs at 50% duty cycle.

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.

(12)

Where:

- 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 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 10

Table 2: Component List with Typical Output Voltage BOM list

					option
					option
					option

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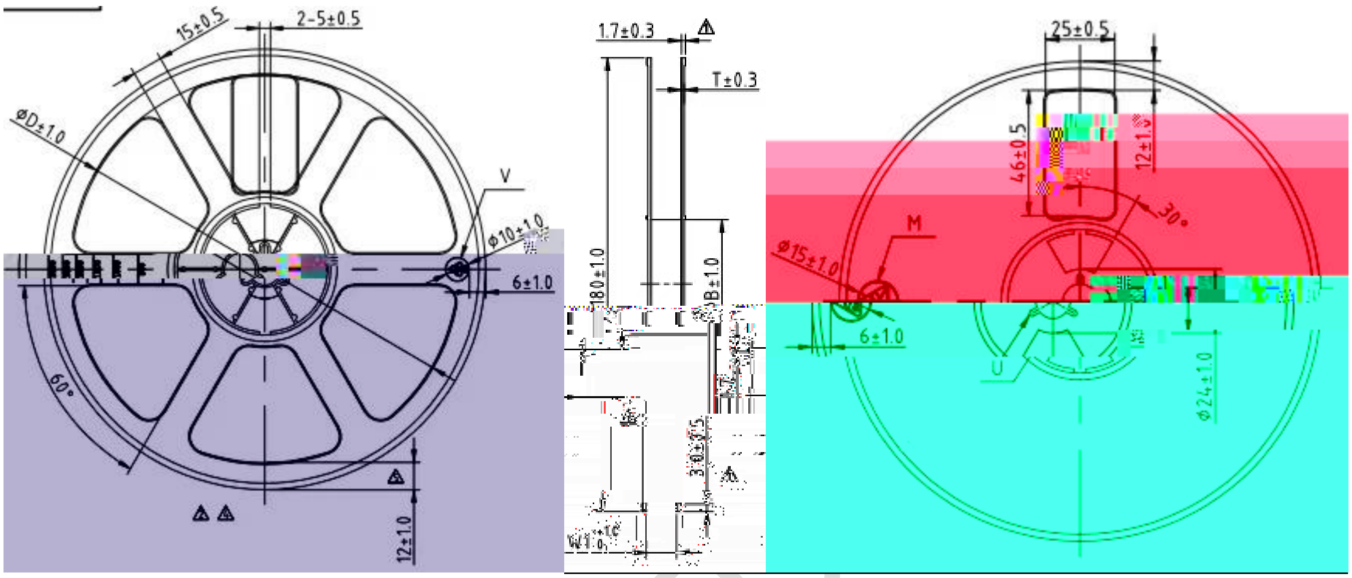
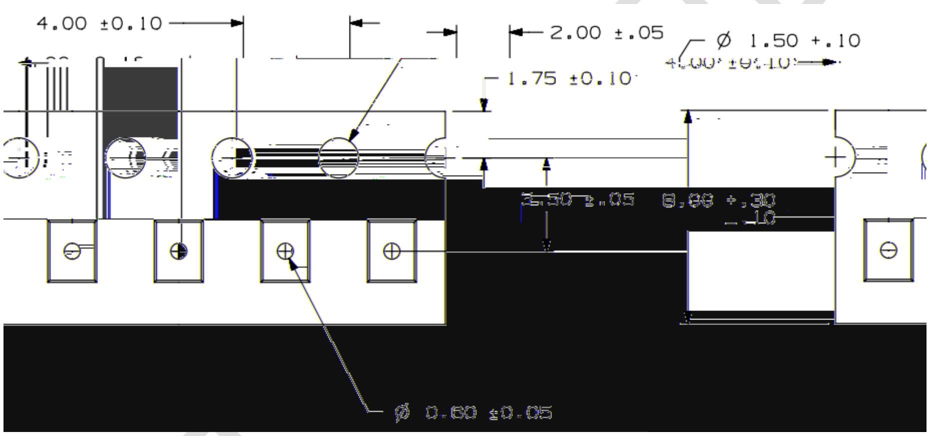
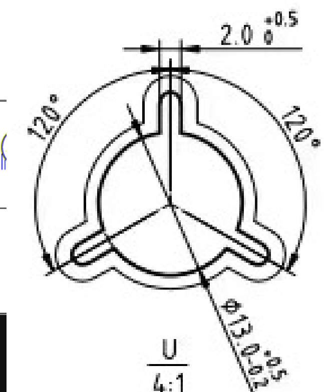
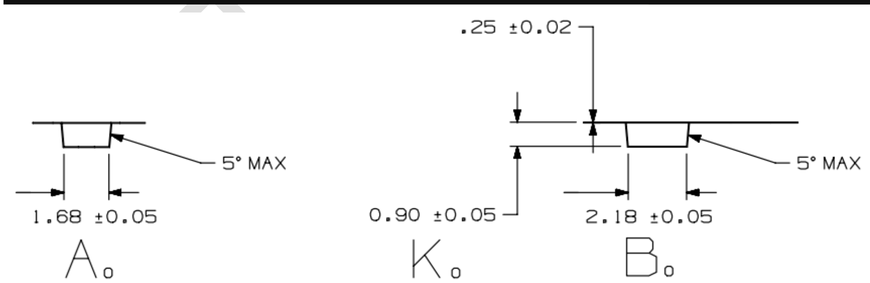
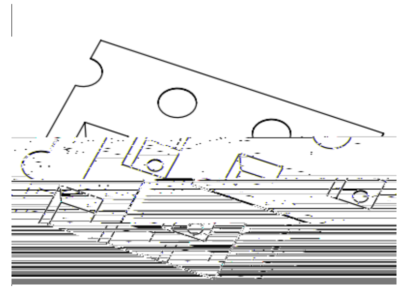
Orderable Device	Package Type	Pins	SPQ
SCT2131FTAR	QFN 1.5mmx2mm	8	3000











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