2A Load Switch with ultra-low quiescent current

1 Descriptions

The SC7631 is an advanced load switch with ultra-low quiescent current of typical 70nA. SC7631 operates with input voltage range from 1.2V to 5.5V. The SC7631 provides ultra-low Quiescent Current I_Q and Shutdown Current I_{SD} to save energy and improve operation life.

The device provides extremely low 60mΩ on resistance R_{ON} and it can deliver up 2A output current with the ultra-low 100nA I_Q. Output short protection and reverse current blocking protection is available to ensure the device in safe operation condition.

SC7631 adopts 4pin CSP 0.77mm x 0.77mm package.

2 Applications

- Mobile Phones
- Wearable Devices
- Battery Powered Devices
- Digital Camera

3 Device Information

ORDER NUMBER	PACKAGE	BODY SIZE
SC7631	WLCSP	0.77mm x 0.77mm

4 Features

- Input Voltage Range from 1.2V to 5.5V
- Low On Resistance
  Ron = 105 mΩ (typ) at Vin = 1.5V
  Ron = 50 mΩ (typ) at Vin = 3.3V
  Ron = 35 mΩ (typ) at Vin = 5.5V
- Low Quiescent Current
  IQ = 60nA (typ) at Vin = 3.3V
- Up to 2A Output Current
- Reverse Current Block Protection
- Output Short Protection
- 150Ω Output Discharge
- 0.77mm x 0.77mm 4-Ball WLCSP Package

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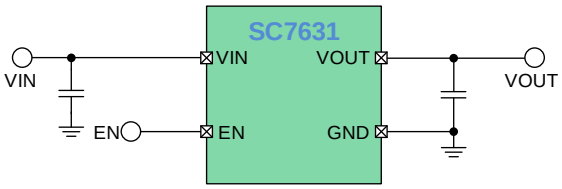
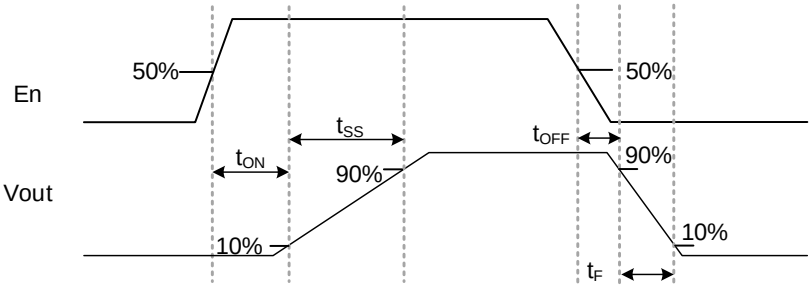
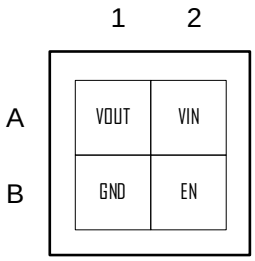
5 Typical Application Circuit





6 Terminal Configuration and Functions

TOP VIEW



TERMINAL		I/O	DESCRIPTION
NUMBER	NAME		
A1	VOUT	Power	Output power pin. Connect a 1μF ceramic capacitor close to the pin.
A2	VIN	Power	Input power supply. Connect a 1μF ceramic capacitor close to the pin.
B1	GND	Power	Ground.
B2	EN	I	Chip enable pin.

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7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted) (1)

PARAMETER		MIN	MAX	Unit
Voltage range at terminals(2)	VIN, VOUT, EN to GND	-0.3	6	V
	Package Thermal Resistance θ_{JA}	140		°C /W
T_J	Operating junction temperature range	-40	150	°C
T_{stg}	Storage temperature range	-65	150	°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to network ground terminal.

7.2 Handling Ratings

PARAMETER	DEFINITION		MIN	MAX	UNIT
ESD(1)	Human body model (HBM) ESD stress voltage(2)	All pins except	-2	2	kV
	Charged device model (CDM) ESD stress voltage(3)		-500	500	V

(1) Electrostatic discharge (ESD) to measure device sensitivity and immunity to damage caused by assembly line electrostatic discharges into the device.

(2) Level listed above is the passing level per ANSI, ESDA, and JEDEC JS-001. JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(3) Level listed above is the passing level per EIA-JEDEC JESD22-C101. JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

PARAMETER		MIN	MAX	UNIT
VIN	VIN voltage range	1.2	5.5	V
EN	EN voltage range	0	6	V
VOUT	VOUT voltage range	0	5.5	V
IOUT	IOUT current range		2	A
T_A	Operating ambient temperature	-40	85	°C
T_J	Operating junction temperature	-40	125	°C

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7.4 Electrical Characteristics

VIN = 1.2V to 5.5V, C_{IN} = 1μF, C_{OUT} = 1μF, typical values are tested at T_A= 25°C, FULL = -40°C to +85°C, unless otherwise noted.

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
SUPPLY CURRENT							
I_Q	Operating Quiescent Current	VIN=5.5V, EN=VIN	25°C		65	100	nA
		VIN=3.3V, EN=VIN			60	80	nA
		VIN=1.2V, EN=VIN			55	90	nA
		VIN=5.5V, EN=VIN	FULL		75	150	nA
		VIN=3.3V, EN=VIN			70	100	nA
		VIN=1.0V, EN=VIN			65	100	nA
I_{SD}	Shutdown Current	VIN=3.3V, EN=GND	25°C		40	70	nA
		VIN=1.0V, EN=GND			30	50	nA
		VIN=3.3V, EN=GND	FULL		40	1500	nA
		VIN=1.0V, EN=GND			30	700	nA
POWER							
R_{ON}	FET ON-resistance	VIN=5.5V, IOUT=200mA	FULL		35	50	mΩ
		VIN=3.3V, IOUT=200mA			50	60	mΩ
		VIN=1.5V, IOUT=200mA			105	150	mΩ
t_{ON}	Turn On Delay	VIN=3.3V, C_L=1uF, R_L=10Ω	FULL		25	56	μs
t_{OFF}	Turn Off Delay	VIN=3.3V, C_L=1uF, R_L=10Ω	FULL		150	235	μs
t_F	Turn Off Timing	VIN=3.3V, C_L=1uF, R_L=10Ω	FULL		30	45	μs
		VIN=3.3V, C_L=0.1uF, R_L=10Ω			5	18	μs
t_{SS}	Soft-Start Timing	VIN=3.3V, C_L=1uF, R_L=10Ω	FULL		120	200	μs
V_{RB}	Reverse Blocking Threshold	VOUT - VIN	FULL		75	110	mV
V_{RBH}	Reverse Blocking Hysteresis		FULL		-300		mV
I_{RB}	Reverse Blocking Current		25°C		450	1000	nA
V_{OS}	Output Short Threshold	VIN - VOUT, 1ms after EN rising	25°C		250		mV
t_{OS}	Output Short FET Turn-off Timer	VIN = 3.3V	25°C		3		ms
R_{DIS}	VOUT Discharge Resistance	VIN = 1.8V	FULL		300	400	Ω
		VIN = 3.3V			150	300	Ω
		VIN = 5.5V			120	200	Ω
EN INPUT							
V_{IH}	EN Input High Threshold	VIN = 3.3V	FULL	1			V
V_{IL}	EN Input Low Threshold	VIN = 3.3V	FULL			0.5	V
I_{EN}	EN Input Pull-Down Current		25°C		25	50	nA
R_{EN}	EN Input Pull-Down Resistance		25°C		6.5		MΩ

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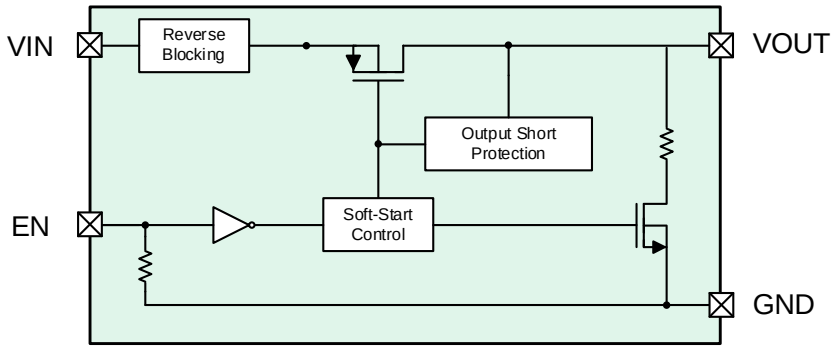
8 Functional Block Diagram



9 Application Information

Output Short Protection

The SC7631 detects input and output voltages to avoid output short condition. When output short or overcurrent event occur, the output voltage is lower than the input voltage. the powerfet will be turned off when 250mV voltage difference between output and input is detected. This protection detection will be blanked within 1ms after EN goes to high.

Reverse Blocking Protection

To avoid current flow from output to input, when the output voltage exceeds the input voltage by 50mV, The internal reverse blocking circuit will turn off the powerfet. Very low current flows from output to input when the main MOSFET is off. The main MOSFET is only able to turn on after output voltage drop below input voltage by 300mV. Reverse blocking circuit is active regardless the state of EN pin. A soft-start sequence would be executed after exiting the reverse blocking state.

Quick Output Discharge

The SC7631 includes the Quick Output Discharge ((QOD) feature, in order to discharge the application capacitor connected on output pin. When EN pin is goes to low, a discharge resistance is connected between the output and ground, pull down the output and prevent it from floating when the device is disabled.

Smart Enable and Output Discharge

The EN pin turn-on threshold is typically 1.0V with 150mV hysteresis. The EN pin has a 6.5MΩ pull down resistor. When EN is high the 7MΩ resistor is disconnected internally to ensure low EN pin current. When EN is low, the device enters shutdown. A 150Ω discharge resistor is connected to VOUT during shutdown.

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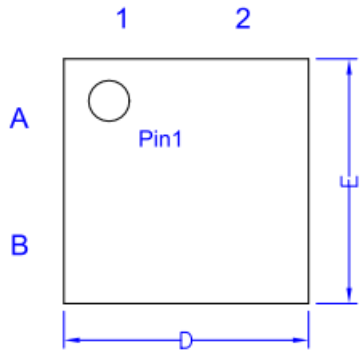
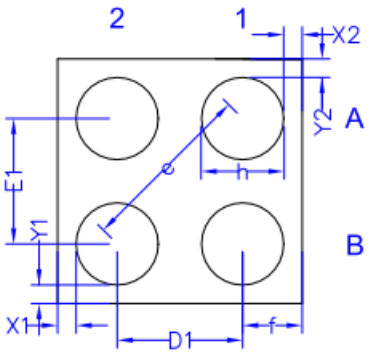
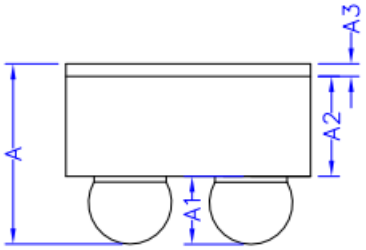
10 MECHANICAL DATA



TOP VIEW
Ball Down



BOTTOM VIEW
Ball Up



SIDE VIEW

Unit:mm

		NO.	Mean	Tolerance
Top Thickness		A	0.575	±0.0405
Ball Height+UBM Thickness		A1	0.220	±0.023
Wafer/Grinding Thickness		A2	0.315	±0.0125
Backside Coating Thickness		A3	0.040	±0.005
Pkg Die Size	X	D	0.7822	±0.025
	Y	E	0.7822	±0.025
Ball diameter		h	0.262	±0.020
Ball Pitch		D1	0.400	NA
		E1	0.400	NA
		e	0.566	NA
Ball edge to die edge		X1	0.0601	NA
		X2	0.0601	NA
		Y1	0.0601	NA
		Y2	0.0601	NA
Ball center to die edge		f	0.1911	NA

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