

N-MOSFET Load Switch Controller

General Description

The RT9727A is a load switch controller to control the external N-MOSFET load switch. The input voltage range of the RT9727A is from 6V to 25V. The RT9727A adopts the constant power discharge method to discharge the residual storages. Besides, the RT9727A also provides enable control function and over temperature protection function.

The RT9727A is available in a SC-70-6 package.

Ordering Information

RT9727A	□
	Package Type
	U6 : SC-70-6
	Lead Plating System
	G : Green (Halogen Free and Pb Free)

Note :

Richtek products are :

- ▶ RoHS compliant and compatible with the current requirements of IPC/JEDEC J-STD-020.
- ▶ Suitable for use in SnPb or Pb-free soldering processes.

Marking Information

For marking information, contact our sales representative directly or through a Richtek distributor located in your area.

Features

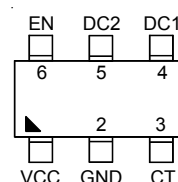
- Driver N-MOSFET Load Switch
- Input Voltage Range : 6V to 25V
- Constant Power Discharge
- Over Temperature Protection
- Enable Control
- RoHS Compliant and Halogen Free

Applications

- Notebook Computers

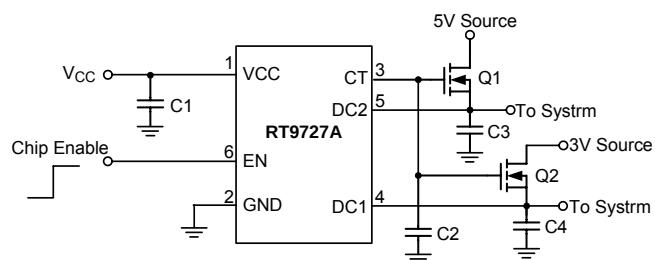
Pin Configurations

(TOP VIEW)

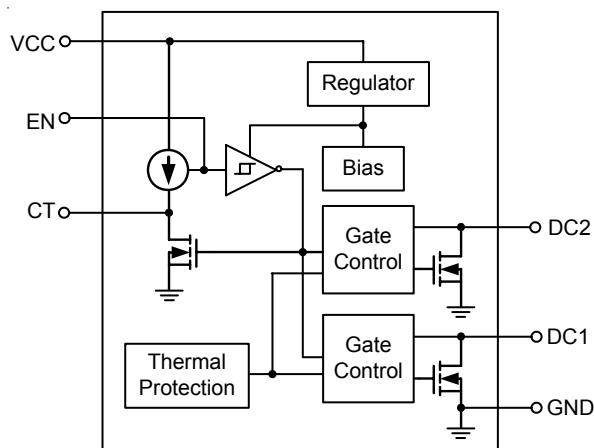


SC-70-6

Typical Application Circuit



Function Block Diagram



Functional Pin Description

Pin No.	Pin Name	Pin Function
1	VCC	Power Supply Input.
2	GND	Ground.
3	CT	Current Source Output. There is an internal 10 μ A current source from VCC to CT.
4	DC1	Discharge Path when EN Pulls Low.
5	DC2	Discharge Path when EN Pulls Low.
6	EN	Chip Enable (Active High). Enable Control of the Internal 10 μ A current source and DCx discharge.

Absolute Maximum Ratings (Note 1)

- VCC, CT to GND ----- -0.3V to 28V
- EN, DC1, DC2 to GND ----- -0.3V to 6V
- Power Dissipation, P_D @ T_A = 25°C
- SC-70-6 ----- 0.3W
- Package Thermal Resistance (Note 2)
- SC-70-6, θ_{JA} ----- 333°C/W
- Lead Temperature (Soldering, 10 sec.) ----- 260°C
- Junction Temperature ----- 150°C
- Storage Temperature Range ----- -65°C to 150°C
- ESD Susceptibility (Note 3)
- HBM (Human Body Mode) ----- 2kV
- MM (Machine Mode) ----- 200V

Recommended Operating Conditions (Note 4)

- Supply Input Voltage, V_{CC} ----- 6V to 25V
- Junction Temperature Range ----- -40°C to 125°C
- Ambient Temperature Range ----- -40°C to 85°C

Electrical Characteristics

(V_{CC} = 10V, V_{EN} = 5V, T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit	
Shutdown Current	I _{SHDN}	V _{CC} = 6V to 25V, EN = Low, DC1 and DC2 = 0	--	5	10	μA	
Quiescent Current	I _Q	V _{CC} = 6V to 25V, EN = High	--	40	65	μA	
Power On Reset Threshold	V _{CCR_TH}	V _{CC} Rising	3.8	4.2	4.6	V	
Power On Reset Hysteresis	V _{CC_hys}		--	0.25	--	V	
CT Output							
CT Source Current	I _{CTsr}	EN = High, CT = 0V	7	10	13	μA	
CT Sink Current	I _{CTsk}	EN = Low, CT = 0.5V	200	--	--	μA	
Discharge Current							
Discharge Current	I _{DCx}	EN = Low, DCx = 5V	18	--	--	mA	
		EN = Low, DCx = 3.3V	20	--	--		
		EN = Low, DCx = 1.6V	50	--	--		
Thermal Shutdown							
Thermal Shutdown	t _{SHDN}		--	160	--	°C	
Thermal Shutdown Hysteresis	t _{SHDN_hys}		--	20	--	°C	
Logic Input							
EN Threshold Voltage	Logic-High	V _{IH}	Rising	2.4	--	--	V
	Logic-Low	V _{IL}	Falling	--	--	0.8	

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

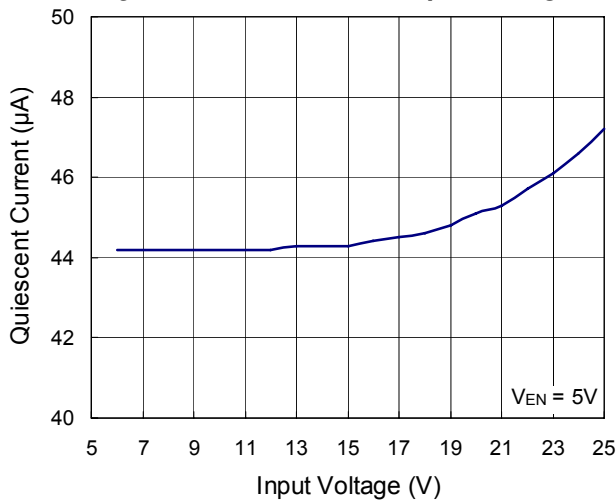
Note 2. θ_{JA} is measured in the natural convection at $T_A = 25^{\circ}\text{C}$ on a low effective thermal conductivity single layer test board of JEDEC 51-3 thermal measurement standard.

Note 3. Devices are ESD sensitive. Handling precaution is recommended.

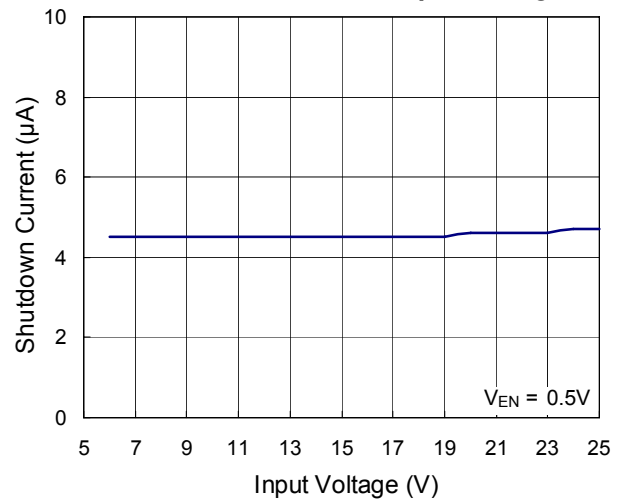
Note 4. The device is not guaranteed to function outside its operating conditions.

Typical Operating Characteristics

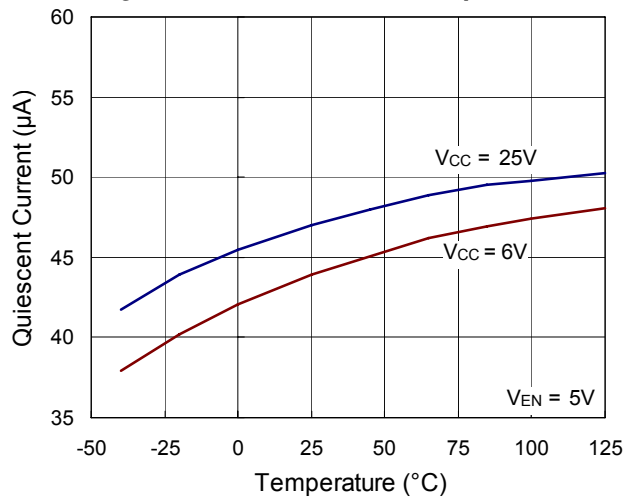
Quiescent Current vs. Input Voltage



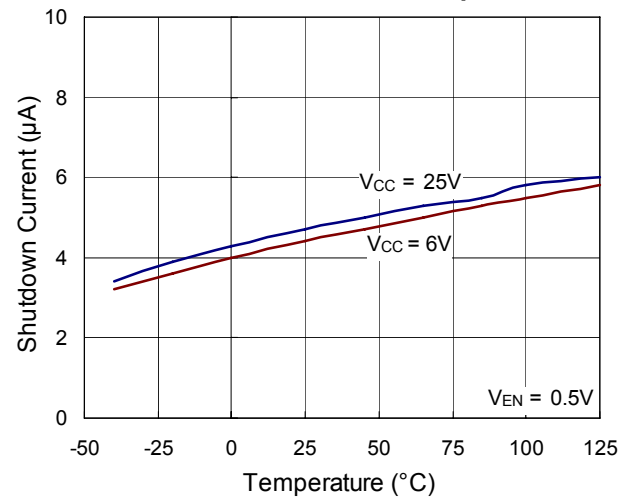
Shutdown Current vs. Input Voltage



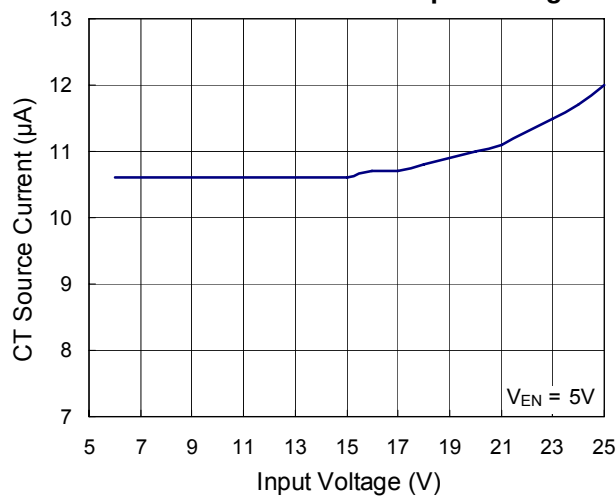
Quiescent Current vs. Temperature



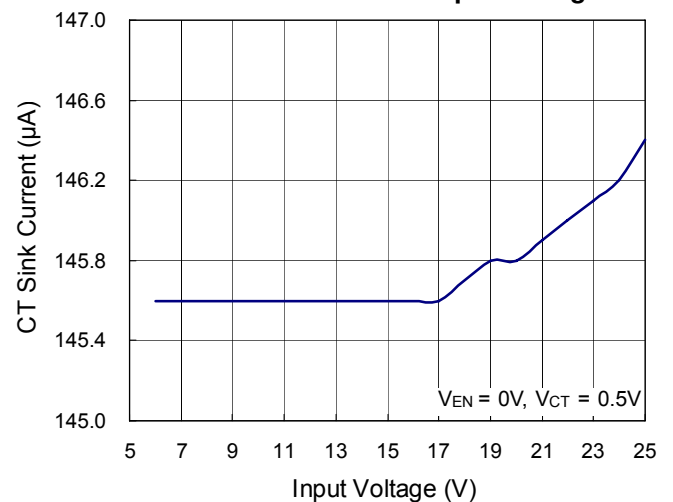
Shutdown Current vs. Temperature



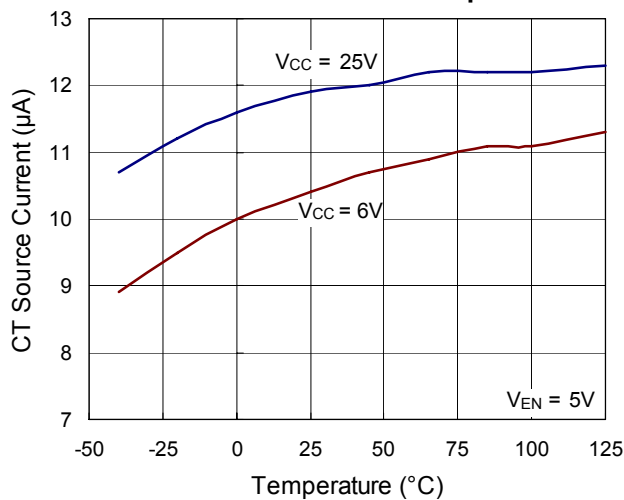
CT Source Current vs. Input Voltage



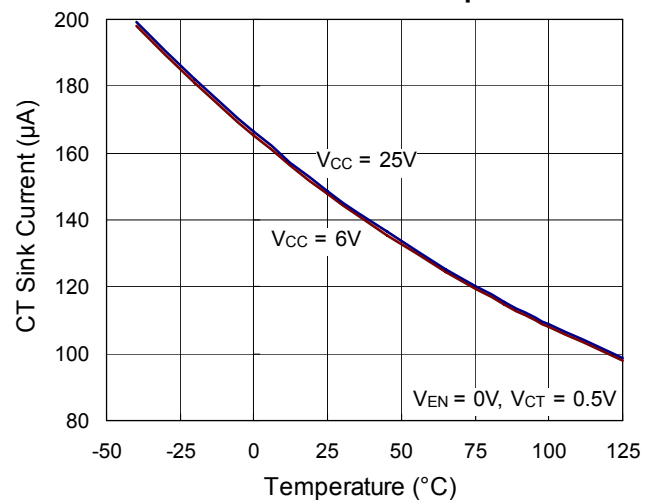
CT Sink Current vs. Input Voltage



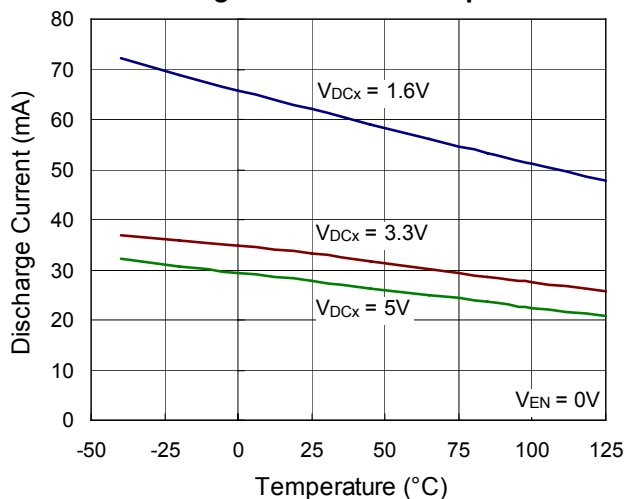
CT Source Current vs. Temperature



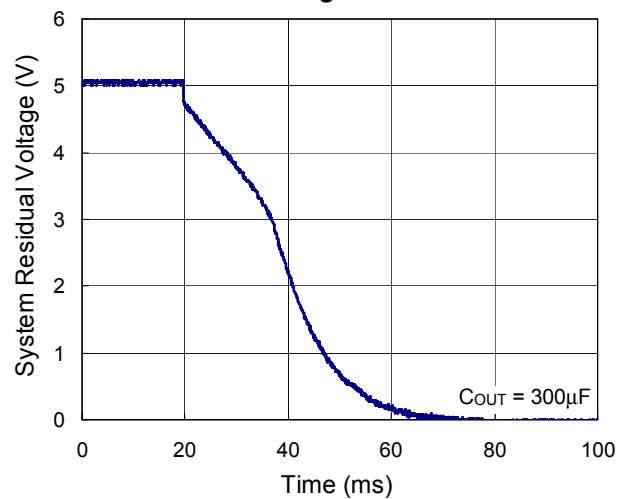
CT Sink Current vs. Temperature



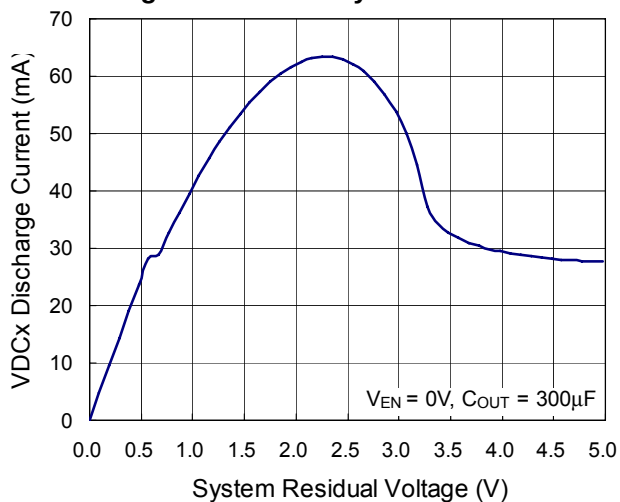
Discharge Current vs. Temperature



VDCx Discharge Characteristic



Discharge Current vs. System Residual Voltage



Applications Information

The RT9727A is a load switch with wide input voltage range from 6V to 25V. It provides two paths for discharging the residual voltage when system shutdown. Besides, the external MOSFET switch On/Off can be controlled by an internal current source from the CT pin to the gate of the MOSFET switch. A novel control is implemented for nearly constant power to discharge the system residual voltages.

Enable & POR

Power-On reset (POR) occurs when the input voltage rises above to approximately 4.5V, the RT9727A will be turned on once the EN pin voltage is higher than 2.4V. After the RT9727A is turned on, there is 10μA (typ.) current flows from CT pin to the gate of the external MOSFET, while both DCx pin discharge MOSFET are off.

Discharge Operation

When EN is low, the RT9727A will discharge the system residual voltage using internal MOSFET connected between the DCx and GND, while CT pin is pulled low. The discharge current depends on the voltage at the DCx pin. While both of the voltages at the DC1 and DC2 pins are lower than 0.5V, the RT9727A will fully turn the internal MOSFET on to pull the DCx pins low.

Thermal Protection

The RT9727A provides thermal shutdown detection to protect the device from over-heating in discharge mode. Once the junction temperature reaches 160°C, the RT9727A will stop discharging until the junction temperature is recovered.

Thermal Considerations

For continuous operation, do not exceed absolute maximum operation junction temperature. The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula :

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

Where $T_{J(MAX)}$ is the maximum operation junction temperature, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance.

For recommended operating condition specification of RT9727A, the maximum junction temperature is 125°C and T_A is the maximum ambient temperature. The junction to ambient thermal resistance θ_{JA} is layout dependent. For SC-70-6 packages, the thermal resistance θ_{JA} is 333°C/W on the standard JEDEC 51-3 single layer thermal test board. The maximum power dissipation at $T_A = 25^\circ\text{C}$ can be calculated by following formula :

$$P_{D(MAX)} = (125^\circ\text{C} - 25^\circ\text{C}) / (333^\circ\text{C/W}) = 0.3\text{W for SC-70-6 package}$$

The maximum power dissipation depends on operating ambient temperature for fixed $T_{J(MAX)}$ and thermal resistance θ_{JA} . For RT9727A package, the Figure 1 of derating curves allows the designer to see the effect of rising ambient temperature on the maximum power dissipation allowed.

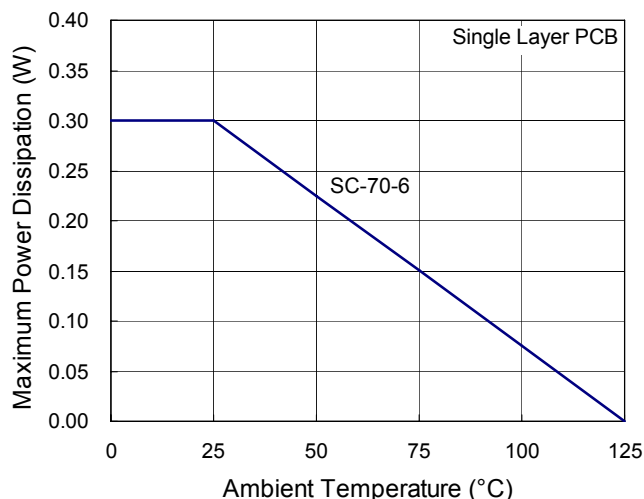


Figure 1. Derating Curves for RT9727A Package

Layout Consideration

For best performance of the RT9727A, the following guidelines must be followed :

- ▶ Input capacitor should be placed close to the IC and connected to ground plane to reduce noise coupling.
- ▶ Keep the main current traces as short and wide as possible.

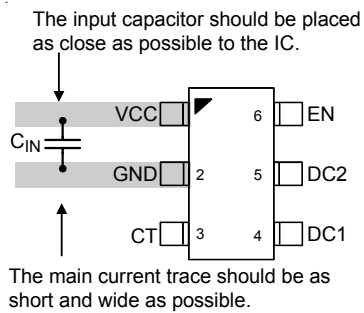
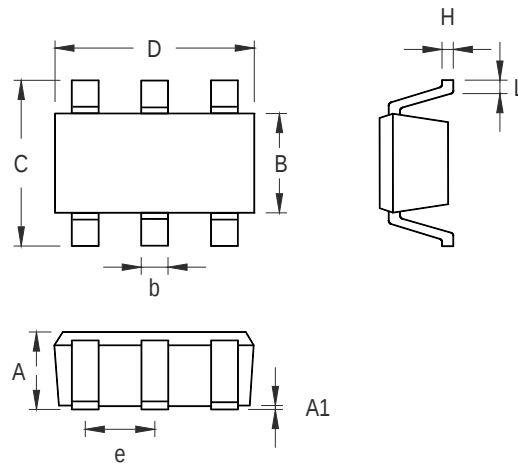


Figure 2. PCB Layout Guide

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.800	1.100	0.031	0.044
A1	0.000	0.100	0.000	0.004
B	1.150	1.350	0.045	0.054
b	0.150	0.400	0.006	0.016
C	1.800	2.450	0.071	0.096
D	1.800	2.250	0.071	0.089
e	0.650		0.026	
H	0.080	0.260	0.003	0.010
L	0.210	0.460	0.008	0.018

SC-70-6 Surface Mount Package

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