JW7112

3A Power-Distribution Switch with Low Resistance

Preliminary Specifications Subject to Change without Notice

DESCRIPTION

JW®7112 is a small, low R_{ON}, single-channel power-distribution switch with controlled turn-on slew rate. The device contains a N-channel MOSFET that can operate over an input voltage range of 2.8V to 16V and can support a maximum continuous current of 3A. Externally programmable rising time control helps to minimize input inrush current during start-up.

The wide input voltage range of the switch makes JW7112 versatile solution for many different voltage rails. The EN pin controls ON/OFF for each JW7112 distribution switch, so one DC/DC converter can deliver power to several requirements and total power efficiency is maximized. JW7112 provide a complete protection solution, including current-limit protection, short-circuit protection (SCP), over-temperature protection (OTP) and under voltage lockout protection (UVLO). The device offers a programmable current-limit threshold via an external resistor.

The JW7112 integrates a 100Ω pull-down resistor for quick output discharge when the switch is turned off.

FEATURES

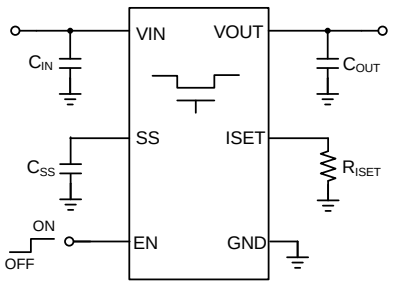
- 2.8V to 16V operating input range
- 50mΩ on resistance
- Low 150μA quiescent current
- Low shutdown current: < 10μA
- ON/OFF control
- Programmable output current limit
- Configurable output voltage rise time
- Constant-current during short-circuit
- Over-temperature protection
- Under voltage lockout protection
- Quick output discharge

APPLICATIONS

- LCD Monitor TV
- USB Ports
- Laptop, Notebook Computers
- Portable Equipment

TYPICAL APPLICATION

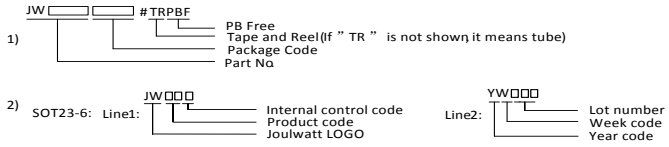
SOT23-6



ORDER INFORMATION

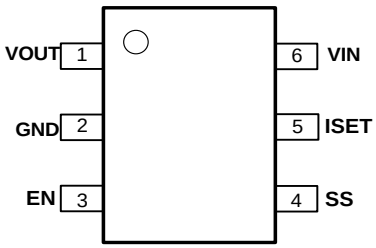
DEVICE[1)]	PACKAGE	TOP MARKING[2)]
JW7112SOTB#TRPBF	SOT23-6	JWH5□ YW□□□

Notes:



PIN CONFIGURATION

TOP VIEW



SOT23-6

ABSOLUTE MAXIMUM RATING[1)]

VIN PIN Voltage .....-0.3V to 26V
VOUT PIN Voltage..... -0.3V to 26V
SS PIN Voltage.....-0.3V to 6V
EN PIN Voltage.....-0.3V to 6V
ISET PIN Voltage.....-0.3V to 6V
Junction Temperature[2)] .....-40 ºC to150ºC
Storage Temperature .....-65ºC to +150ºC
ESD (HBM) …….....±1kV
Peak Power…….....16W

RECOMMENDED OPERATING CONDITIONS[3)]

VIN PIN Voltage ..... 2.8V to 16V
EN PIN Voltage.....0V to 5.5V
C_{SS_MIN}.....1nF
Operating Junction Temperature…..... -40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
SOT23-6	200	130ºC/W

Note：

1) Exceeding these ratings may damage the device. These stress ratings do not imply function operation of the device at any other conditions beyond those indicated under RECOMMENDED OPERATING CONDITIONS.

2) The JW7112 includes thermal protection that is intended to protect the device in overload conditions. Continuous operation over the specified absolute maximum operating junction temperature may damage the device.

3) The device is not guaranteed to function outside of its operating conditions.

4) Measured on JESD51-7, 4-layer PCB

ELECTRICAL CHARACTERISTICS

TA = +25°C, VIN = 12V, V_{EN} = 5V, unless otherwise stated.

Item	Symbol	Condition[5)]		Min.	Typ.	Max.	Units
Power Supply							
Input Quiescent Current	I_Q	V_{IN} = 12V,V_{EN} = 5V, V_{OUT} = Open			130	200	μA
Input Shutdown Current	I_{SHDN}	V_{IN} = 12V, V_{EN} = 0V V_{OUT} = Open			1	2	μA
Input UVLO	V_{UVLO}	VIN Rising		2.45	2.6	2.75	V
Input UVLO Hysteresis	Δ V_{UVLO}	VIN Decreasing			150		mV
Power Switch							
Switch On-Resistance	$R_{DS(ON)}$	SOP-8P	T_J = +25°C, V_{IN} = 12V		60		mΩ
		SOT2x3-5	T_J = +25°C, V_{IN} = 12V		50		
		SOT2x3-6	T_J = +25°C, V_{IN} = 12V		65		
		DFN2X2-6	T_J = +25°C, V_{IN} = 12V		60		
Current Limit and Short Circuit Protections							
Current Limit Voltage	V_{ISET}				0.4		V
Current-Limit (maximum DC output current)	I_{LIMIT}	V_{IN} = 12V,V_{EN} = 5V, R_{SET}=20K VOUT > VIN – 1V		2	2.5	3	A
Short Circuit Voltage Threshold[5)]	V_{SC}				1		V
Short Circuit Current	I_{SHORT}	V_{IN} = 12V,V_{EN} = 5V,VOUT < 1V			0.3		A
Soft-Start Control							
Soft-Start Current	I_{SS}	V_{IN} = 12V,V_{EN} = 5V		1.5	2	2.5	μA
Soft-Start Time	t_R	V_{IN} = 12V, V_{EN} = 5V, C_{OUT} = 1μF, C_{SS} = Open		1	1.38	1.7	ms
		V_{IN} = 12V, V_{EN} = 5V, C_{OUT} = 1μF, C_{SS} = 1nF			1		ms
Soft-start Discharge Resistance	R_{SS_DIS}	V_{IN} = 12V,V_{EN} = 0V			650		Ω
Enable Pin							
EN Rising Threshold	V_{ENH}	V_{EN} rising			1.215	1.4	V
EN Falling Threshold	V_{ENL}	V_{EN} falling		0.95	1.135		V
EN Hysteresis	V_{EN_HYST}				80		mv
EN Input Leakage Current	$I_{LEAK-EN}$	V_{IN} = 12V, V_{EN} = 0V and 5V				1	μA
Turn-On Time	t_{ON}	C_{OUT} = 1uF, R_L = 100Ω. See Figure 1.		1.25	1.5	1.75	ms
Turn-Off Time	t_{OFF}	C_{OUT} = 1uF, R_L = 100Ω. See Figure 1.		50	55	60	μs
Turn-On Delay Time	t_D					300	μs
Output Discharge							
Discharge Resistance	R_{DIS}	V_{IN} = 12V, V_{EN} = 0V			110		Ω

Over-Temperature Protection (OTP)						
Thermal Shutdown Threshold[5)]	T_{SHDN}	Enabled, V_{OUT} = Open, T_J rising		160		°C
Thermal Shutdown Hysteresis[5)]	T_{HYS}	Enabled, V_{OUT} = Open, T_J falling		60		°C

Note：

5) Guaranteed by design.

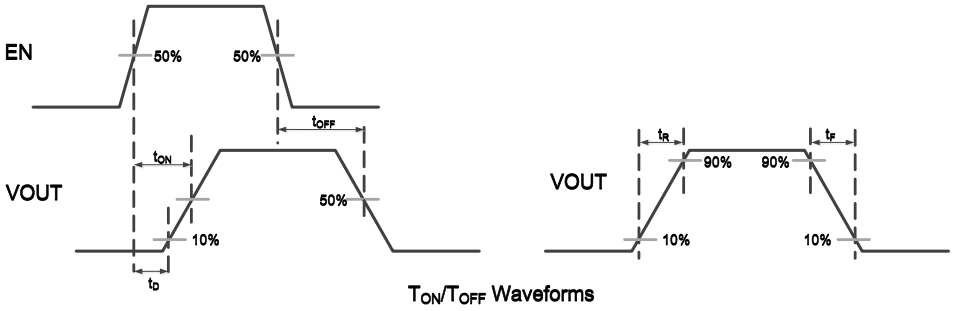
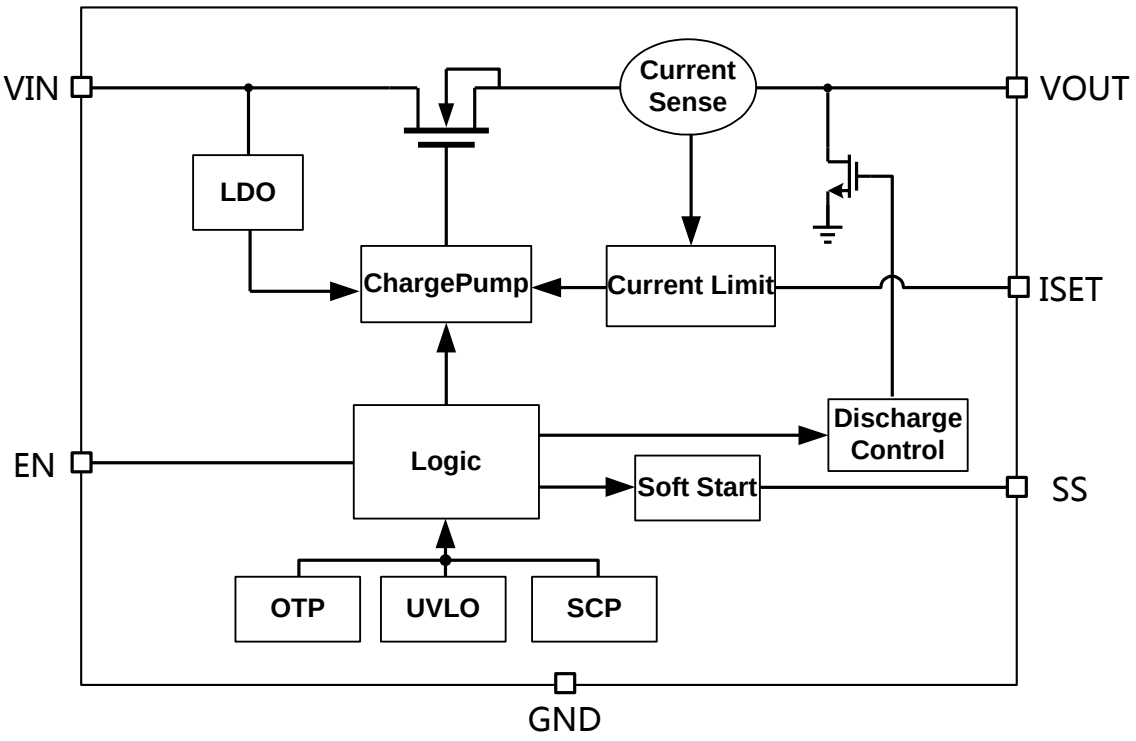


Figure 1. Voltage Waveforms

PIN DISCRIPTION

Pin SOT23-6	Name	Description
6	VIN	Power supply and switch input
2	GND	Ground.
3	EN	Active high control input. Do not leave floating.
4	SS	Soft-start pin. Place a 1nF or greater capacitor between this pin to ground.
5	ISET	Current-limit set pin. Connect a resistor to ground to adjust OCP level.
1	VOUT	Switch output

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Under-voltage Lockout (UVLO)

The JW7112 power switch integrates an under-voltage lockout circuit to keep the output shutting off until internal circuitry is operating properly. The UVLO circuit has hysteresis and a de-glitch feature so that it will typically ignore undershoot transients on the input. When input voltage exceeds the UVLO threshold, the output voltage starts a soft-start to reduce the inrush current.

Current Limit Protection

The JW7112 power switch provides the current limit protection. During current limit, the device limits output current at current limit threshold programmed through external resistor. For reliable operation, the device should not be operated in current limit for extended period time.

Short Circuit Protection (SCP)

When the output voltage drops below VIN-1V, which is caused by over load or short-circuit, or at the very beginning of the soft-start when VOUT<1V, the devices limit the output current down to a safe level. The short circuit current-limit is used to reduce the power dissipation during short-circuit condition. If the junction temperature is over the thermal shutdown temperature, the device will trigger the over temperature protection.

Soft-Start

The JW7112 provides an adjustable soft-start circuitry to control rise rate of the output voltage and limit the current surge during start-up. The soft-start ramp-up rate is controlled by a capacitor from SS pin to ground. the soft start time can be calculated by this following equation:

$$t_R = R_0 * C_{SS} / 6$$

Where t_R = soft start time

$$R_0 = 6M\Omega$$

t_R is the soft start time of VOUT rising from 10% to 90%, of which unit is millisecond. C_{SS} is the value of the capacitor connected from SS pin to GND, of which unit is micro-Farad. VIN is the amplitude of input voltage applied to this device, of which unit is volt. I_{SS} is the SS pin charge current. If the SS pin is left floating the soft start time is 1.38ms when VIN=12V.

Enable/Disable

Pull the EN below 0.6V to disable the device and pull EN above 2V to enable the device. When the IC is disabled the supply current is reduced to less than 30μA. The enable input is compatible with both TTL and CMOS logic levels. The EN pin cannot be left floating.

Under-Voltage Lockout (UVLO)

Whenever the input voltage falls below UVLO threshold, the power switch is turned off. This facilitates the design of hot-insertion systems where it is not possible to turn off the power switch before input power is removed.

Over-Temperature Protection

Thermal protection prevents the IC from damage when the die temperature exceeds safe margins. This mainly occurs when heavy-overload or short-circuit faults occurs. The JW7112 implements a thermal sensing circuit to monitor the operating junction temperature. Once the die temperature rises to approximately +160°C , the thermal protection feature activates as follows: The internal thermal sense circuitry turns the power switch off , thus preventing the power switch from damage. Once the junction temperature drops to 100°C, the MOSFET restarts to work, resulting in a pulsed output during continuous thermal protection. For normal operation, the junction temperature cannot exceed T_J = 125℃.

Current Limit Setting

The current limit can be set by connecting a resistor from the current limit adjustable pin ISET to ground. Current limit threshold equation(I_{LIMIT}) is as follows:

$$I_{LIMIT}\,(mA) = \frac{45677\,V}{R_{ISET}\,K\Omega} + 233\,mA$$

APPLICATION INFORMATION

Input Capacitor

A 10μF or higher ceramic bypass capacitor from VIN to GND, located near the JW7112, is strongly recommended to suppress the ringing during over-load or short-circuit fault event. Without the bypass capacitor, the over-load or output short may cause sufficient ringing on the input (from supply lead inductance) to damage internal control circuitry. Input capacitor is especially important to prevent VIN from ringing too high in some applications where the inductance between power source to VIN is large due to poor PCB layout or purposely adding an inductive component in front of VIN pin.

When the VIN's supply voltage is higher, say 14V or 16V, it is required to add some adequate amount of capacitance of input capacitor into VIN pin for overshoot suppression because a slight ringing of VIN is most likely to exceed VIN's absolute maximum rating, or else the device could be burnout during over load conditions.

Output Capacitor

A low-ESR 10μF MLCC, aluminum electrolytic or tantalum between VOUT and GND is strongly recommended to reduce the voltage droop during hot-attachment of downstream peripheral. Higher-value output capacitor is better when the output load is heavy. Additionally, bypassing the output with a 0.1μF ceramic capacitor improves the immunity of the device to short-circuit transients.

Soft-start Capacitor

The JW7112 has a built-in adjustable soft-start control for user to set an optimum soft-start time for the application. The soft-start time can be calculated by the equation, described in the paragraph of Soft-Start in Functional Description section. Please note that there is minimum value of soft start capacitor in different VIN input voltage. Please make sure the C_{SS} is in the recommended value.

Layout Consideration

The PCB layout should be carefully performed to maximize thermal dissipation and to minimize voltage drop, droop and EMI. The following guidelines must be considered:

1. Please place the input capacitors near the VIN pin as close as possible.
2. Output decoupling capacitors for load must be placed near the load as close as possible for decoupling high frequency ripples.
3. Locate JW7112 and output capacitors near the load to reduce parasitic resistance and inductance for excellent load transient performance.
4. The negative pins of the input and output capacitors and the GND pin must be connected to the ground plane of the load.
5. Keep VIN and VOUT traces as wide and short as possible.

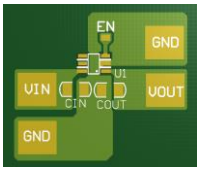
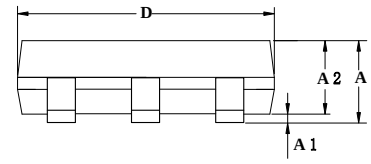
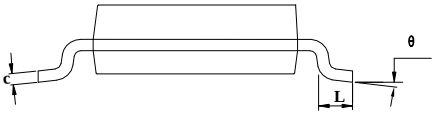


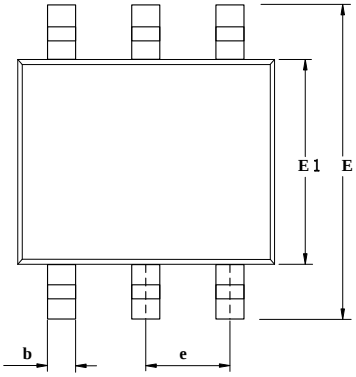
Figure1. PCB Layout Recommendation

PACKAGE OUTLINE

SOT23-6 UNIT: mm







SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	1.05	1.15	1.25
A1	0	0.05	0.15
A2	0.95	1.10	1.20
b	0.20	0.40	0.60
c	0.05	—	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95（BSC)		
L	0.30	0.45	0.60
θ	0°	—	8°

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