

**Pin Definition:**

1. Output
2. Ground
3. Enable
4. Input
5. Input

**TS1900****Ultra Low Quiescent Current Smart Load Switch****General Description**

TS1900 is a high side slew rate controlled smart load switch. The slew rate control in TS1900 can effectively avoid the large in-rush current which is commonly observed in normal power switches. Moreover, the level shift in TS1900 allows customers to control 1.8 to 6.5V system with 1.5V logic and without sacrificing leakage current.

TS1900 has typical low  $R_{DS(on)}$  at 100mΩ, it allows large power handling capabilities. And very low quiescent current and fast load discharge make it ideal for power sensitive applications nowadays.

**Features**

- 1.8 to 6.5V Input Voltage Range
- Slew Rate Limited at 100uS
- Very Low  $R_{DS(ON)}$ , Typically 100mΩ
- Less than 1uA Shutdown Current
- Very Low Quiescent Current, Typically 2uA
- Fast Shutdown Load Discharge
- Thermal Fault Protection
- TTL / CMOS Input Logic Level
- 2KV ESD Rating
- EMI Free Circuit

**Applications**

- Cellular and Smart Phone
- Hot Swap Supplies
- Microprocessors and DSP Core Supplies
- PDAs
- MP3 Players
- Digital Still and Video Cameras
- Portable Instruments

**Absolute Maximum Rating**

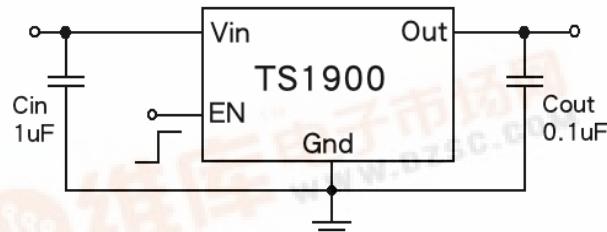
Parameter	Symbol	Limit	Unit
Input Supply Voltage	$V_{IN}$ to Gnd	-0.3 to 6.5	V
Enable to Ground Voltage	$V_{EN}$ to Gnd	-0.3 to 6.5	V
Output to Ground Voltage	$V_{OUT}$ to Gnd	-0.3 to 6.5	V
Power Dissipation	$P_D$	Internally Limited	
Maximum Continues Current	$I_{CONTINUE}$	2.2	A
Junction Temperature Range	$T_J$	+150	°C
Storage Temperature Range	$T_{STG}$	-65 ~ +150	°C
ESD HBM / MM		2 / 200	KV / V

**Ordering Information**

Part No.	Package	Packing
TS1900CX5 RF	SOT-25	3Kpcs / 7" Reel

**Pin Description**

Pin	Name	Function
1	Out	Drain of P-CH Power MOSFET
2	Gnd	Gnd Pin. Connect directly to local ground plane.
3	EN	Enable Control Input
4,5	Vin	Source of P-CH Power MOSFET

**Application Circuit**

**Recommended Operating Conditions (Note 2)**

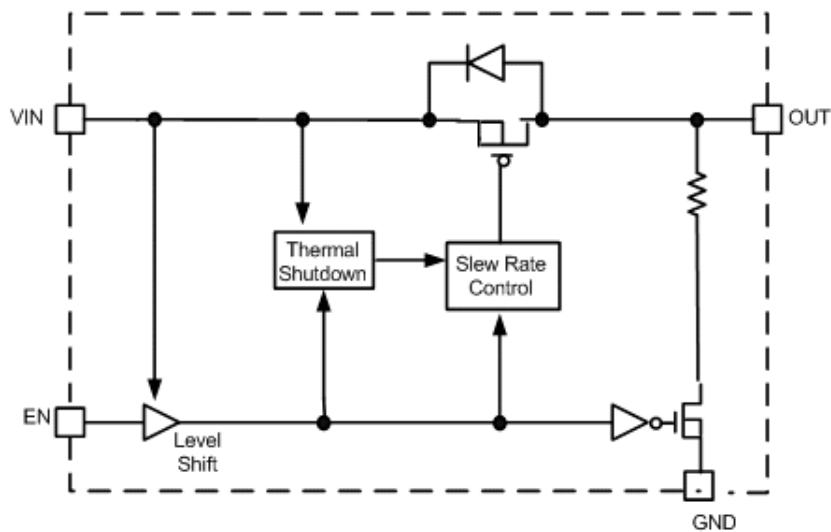
Parameter	Symbol	Limit	Unit
Supply Voltage	$V_{IN}$	-0.3 to 6.5	V
Operating Temperature Range	$T_{OPR}$	-40 to +85	°C
Junction to Ambient Thermal Resistance (PCB mounted)	$R\Theta_{JA}$	220	°C/W

**Note:** 1. Exceeding these ratings may damage the device.

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

**Electrical Specifications ( $V_{IN}=5V$ ,  $V_{EN}=1.5V$ ,  $T_A=25^\circ C$ , unless otherwise noted)**

Parameter	Symbol	Test Conditions	Min	TYP	MAX	Units
Input Voltage	$V_{IN}$		1.8	5	6.5	V
Quiescent Current	$I_Q$	$V_{EN}=1.5V$	--	2	4	µA
Shutdown Current	$I_{SD}$	$V_{EN}=0V$ , Out = Open	--	0.05	1	µA
Off Switch Current	$I_{SO}$	$V_{EN}=0V$ , $V_{OUT} = 0$	--	0.05	1	µA
On Resistance	$R_{DS(ON)}$	$V_{IN}=5V$ @ 100mA	--	100	130	mΩ
		$V_{IN}=4.2V$ @ 100mA	--	110	140	
		$V_{IN}=3V$ @ 100mA	--	130	160	
		$V_{IN}=1.8V$ @ 100mA	--	200	250	
EN Input Logic Low	$V_{IL}$	$R_{OUT} = 10\Omega$	--	--	0.4	V
EN Input Logic High	$V_{IH}$	$R_{OUT} = 10\Omega$	1	--	--	V
EN Input Leakage	$I_{SINK}$	$V_{EN}=5.5V$	--	0.01	1	µA
Output Turn-On Delay	$T_{D(ON)}$	$R_{OUT} = 10\Omega$	--	40	80	uS
Output Turn-On Rise Time	$T_{ON}$	$R_{OUT} = 10\Omega$	--	100	150	uS
Output Turn-Off Delay	$T_{D(OFF)}$	$R_{OUT} = 10\Omega$	--	4	10	uS
Output Pull-Down Resistance	$R_{PD}$	$V_{EN}=0V$	--	150	250	Ω
Thermal Shutdown Temperature	$T_{SD}$		140	160	180	°C
Thermal Recovery Temperature	$T_R$		120	140	160	°C

**Block Diagram**




# TS1900

## Ultra Low Quiescent Current Smart Load Switch

### Application Information

The TS1900 featured very low quiescent current and very low RDS(ON) and making them ideal for battery-powered applications. The ENABLE control pin is TTL compatible and driven by 1.5V beyond making the TS1900 an ideal level-shifting load switch.

#### **Input Capacitor Selection**

A 1uF or larger input capacitor is recommended to prevent load transients from affecting upstream circuits.  $C_{IN}$  should be located as close to the device  $V_{IN}$  pin as practically. There is no specific requirement type of capacitor is recommended. However, for higher current operation, ceramic capacitors are recommended for  $C_{IN}$ .

$$L = [V_{OUT} \times (V_{IN} - V_{OUT})] / [V_{IN} \times (\Delta I_L \times F_{osc})]$$

Where  $\Delta I_L$  is the inductor ripple current. Larger inductance is recommended for better efficiency in light load condition.

#### **Output Capacitor Selection**

For proper slew operation, a 0.1uF or greater is recommended. The output capacitor has also no specific capacitor type requirement. If desired,  $C_{OUT}$  maybe increased without limit to accommodate any load transient

#### **Reverse Output-to-Input Voltage Conditions and Protection**

Under normal conditions, there is a parasitic diode between the output & input of the load switch. In case of  $V_{OUT}$  exceeding  $V_{IN}$ , this would forward bias the internal parasitic diode and allow excessive current flow into the  $V_{OUT}$  pin and possibly damage the load switch.

In applications, where there is a possibility of  $V_{OUT}$  exceeding  $V_{IN}$  for brief periods of time during operation, the use of larger value  $C_{IN}$  capacitor is highly recommended. A larger value of  $C_{IN}$  with respect to  $C_{OUT}$  will affect a slower  $C_{IN}$  decay rate during shutdown, thus preventing  $V_{OUT}$  from exceeding  $V_{IN}$ .

In case of extended period of time for  $V_{OUT}$  exceeding  $V_{IN}$ , it is recommended to place a Schottky diode from  $V_{IN}$  to  $V_{OUT}$ .

#### **Thermal Considerations**

The TS1900 is designed to deliver a continuous load current. The maximum limit is package power dissipation. At any given ambient temperature, the maximum package power dissipation can be determined by the following equation:

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

Constraints for the TS1900 are maximum  $T_{J(MAX)} = 125^\circ C$ , and package thermal resistance,  $\theta_{JA} = 120^\circ C / W$ . The maximum continuous output current for TS1900 depends on package power dissipation and the  $R_{DS(ON)}$  of MOSFET at  $T_{J(MAX)}$ . Typical conditions are calculated under normal ambient condition where

$$T_A = 25^\circ C \text{ At } 85^\circ C, P_{D(MAX)} = 333mW. \text{ At } T_A = 25^\circ C, P_{D(MAX)} = 833mW.$$

The maximum current is calculated by the following equation:

$$I_{OUT} < (P_{D(MAX)} / R_{DS(MAX)}) < (1/2)$$

For example, if  $V_{IN} = 5V$ ,  $R_{DS(MAX)} = 160m\Omega$  and  $T_A = 25^\circ C$ ,  $I_{OUT(MAX)} = 2.2A$ .

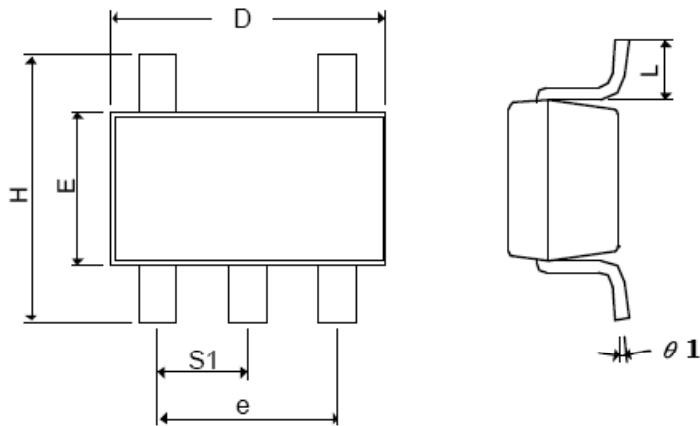
Thermal Shutdown is employed to protect the device damage when over temperature  $160^\circ C$ .

#### **PCB Layout Consideration**

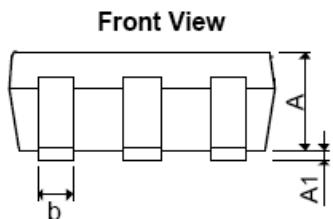
To maximize TS1900 performance, some board layout rules should be followed:

$V_{IN}$  and  $V_{OUT}$  should be routed using wider than normal traces, and GND should be connected to a ground plane. For best performance,  $C_{IN}$  and  $C_{OUT}$  should be placed close to the package pins.

**SOT-25 Mechanical Drawing**



SOT-25 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A+A1	0.09	1.25	0.0354	0.0492
B	0.30	0.50	0.0118	0.0197
C	0.09	0.25	0.0035	0.0098
D	2.70	3.10	0.1063	0.1220
E	1.40	1.80	0.0551	0.0709
E	1.90 BSC		0.0748 BSC	
H	2.40	3.00	0.09449	0.1181
L	0.35 BSC		0.0138 BSC	
$\Theta 1$	0°	10°	0°	10°
S1	0.95 BSC		0.0374 BSC	





**TS1900**

Ultra Low Quiescent Current Smart Load Switch

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