TS2026

Dual-Channel Power Distribution Switch

SOP-8

Pin assignment:

1. ENA
2. FLGA
3. FLGB
4. ENB
5. OUTB
6. GND
7. IN
8. OUTA

140mΩ max. on-resistance per channel
2.7V to 5.5V operating range
Under voltage lockout

General Description

The TS2026 is high-side MOSFET switches optimized for general-purpose power distribution requiring circuit protection. The TS2026 are internally current limited and have thermal shutdown that protects the device and load. When a thermal shutdown fault occurs, the output is latched off until the faulty load is removed. Removing that load or toggling the enable input will reset the device output. Both device employ soft-start circuitry that minimized inrush current in application where highly capacitive loads are employed. A fault status output flag is asserted during over current and thermal shutdown conditions. Transient faults are internally filtered.

Features

- ✧ 140mΩ max. on-resistance per channel
- ✧ 2.7V to 5.5V operating range
- ✧ 500mA min. continuous current per channel
- ✧ Short-circuit protection with thermal shutdown
- ✧ Thermal isolated channels.
- ✧ Fault status flag with 3ms filter eliminates false assertions.
- ✧ Under voltage lockout
- ✧ Reverse current flow blocking (no “body diode”)
- ✧ Logic-compatible inputs
- ✧ Soft-start circuit
- ✧ Low quiescent current

Ordering Information

Part No.	Operating Temp. (Ambient)	Package
TS2026CS	-20 ~ +85 °C	SOP-8

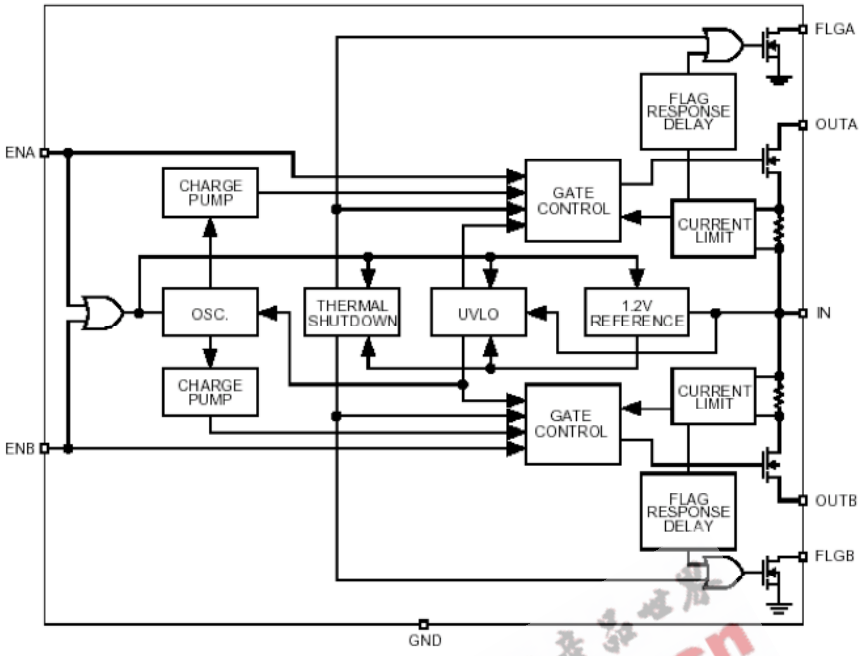
Applications

- ✧ USB peripherals
- ✧ General purpose power switching
- ✧ ACPI power distribution
- ✧ Notebook PCs
- ✧ PDAs
- ✧ PC card hot swap

Absolute Maximum Rating

Supply Voltage	V_{IN}	+6	V
Fault Flag Voltage	V_{FLG}	+6	V
Fault Flag Current	I_{FLG}	25	mA
Output Voltage	V_{OUT}	+6	°C
Output Current	I_{OUT}	Internal Limited	
Enable input	I_{EN}	-0.3 ~ +3	V
Storage Temperature	T_{STG}	-65 ~ +150	°C

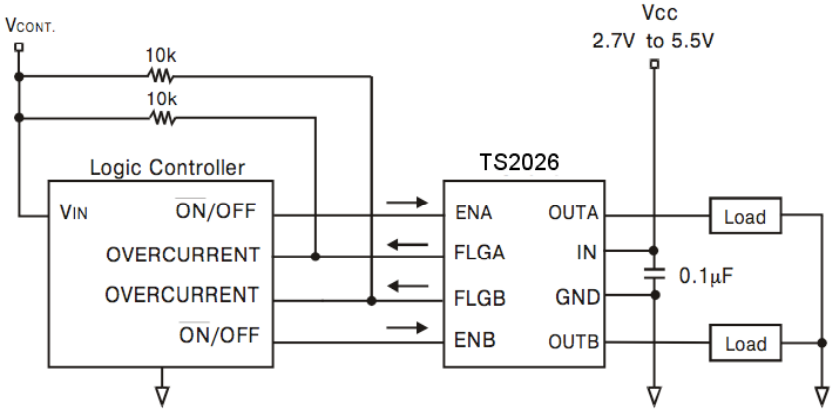
Block Diagram



Pin Description

Pin Number	Pin Name	Pin Function
1	ENA	Switch A Enable (Input): Logic-compatible enable input. Active high (H) or active low (L)
2	FLGA	Fault Flag A (Output): Active-low, open-drain output. Indicated over current or thermal shutdown conditions. Over current conditions mush last longer than t_D in order to assert FLGA
3	FLGB	Fault Flag B (Output): Active-low, open-drain output. Low Indicated over current or thermal shutdown conditions. Over current conditions mush last longer than t_P in order to assert FLGA
4	ENB	Switch B Enable (Input): Logic-compatible enable input. Active-high (H) or active-low
5	OUTB	Switch B (Output)
6	GND	Ground
7	IN	Input: Switch and logic supply input
8	OUTA	Switch A (Output)

Typical Application



Electrical Characteristics

Vin=5V, T_A = 25 °C, bold values indicate -40 °C ≤ T_A ≤ 85°C unless noted

Parameter	Symbol	Condition	Min.	Typ.	Max.	Units
Supply Current	I_{DD}	TS2026-L, V_{ENA}=V_{ENB}≥2.4V (switch off), OUT = open	--	0.75	5	A
		TS2026-H, V_{ENA}=V_{ENB}≤0.8V (switch on), OUT = open	--	100	160	A
Enable Input threshold	V_{EN}	Low-to-high transition	--	1.7	2.4	V
		High-to-low transition	0.8	1.455	--	V
Enable Input Hysteresis			--	250	--	mV
Enable Input Current	I_{EN}	V_{ENA}= 0V to 5.5V	-1	0.01	1	A
Enable Input Capacitance			--	1	--	pF
Switch Resistance Note 4	$R_{DS(ON)}$	V_{IN}= 5V, I_{OUT}= 500mA	--	90	140	mΩ
		V_{IN}= 3.3V, I_{OUT}= 500mA	--	100	160	mΩ
Output Leakage Current		TS2026-H, V_{ENX}≤0.8V TS2026-L, V_{ENX}≥2.4V	--	--	10	A
Output Turn-on Delay	t_{ON}	R_L=10Ω, C_L=1F, see “Timing Diagrams”	--	1.3	5	mS
Output Turn-on Rise Time	t_R	R_L=10Ω, C_L=1F, see “Timing Diagrams”	--	1.15	4.9	mS
Output Turn-off Delay	t_{OFF}	R_L=10Ω, C_L=1F, see “Timing Diagrams”	--	35	100	S
Output Turn-off Fall Time	t_F	R_L=10Ω, C_L=1F, see “Timing Diagrams”	--	32	100	S
Short-Circuit Output Current	I_{LIMIT}	V_{OUT}= 0V, enable into short-circuit	0.5	0.9	1.25	A
Current –Limit Threshold		Ramped load applied to output	--	1.0	1.25	A
Short-Circuit Response Time		V_{OUT}= 0V to I_{OUT}= I_{LIMIT} (short applied to output)	--	20	--	S
Over current Flag Response Delay	t_D	V_{IN}=5V, apply V_{OUT}=0V Until FLG low	1.5	3	7	mS
		V_{IN}=3.3V, apply V_{OUT}=0V Until FLG low	TBD	3	--	mS
Under voltage Lockout Threshold		V_{IN} rising	2.2	2.4	2.7	V
		V_{IN} falling	2.0	2.15	2.5	V
Error Flag Output Resistance		I_L =10mA, V_{IN} =5V	--	10	25	Ω
		I_L =10mA, V_{IN} =3.3V	--	15	40	Ω
Error Flag Off Current		V_{FLAG} =5V	--	--	10	A
Over temperature Threshold Note 5		T_J increasing, each switch	--	140	--	°C
		T_J decreasing, each switch	--	120	--	°C
		T_J increasing, both switch	--	160	--	°C
		T_J decreasing, both switch	--	150	--	°C

Note 1. Exceeding the absolute maximum rating may damage the device.

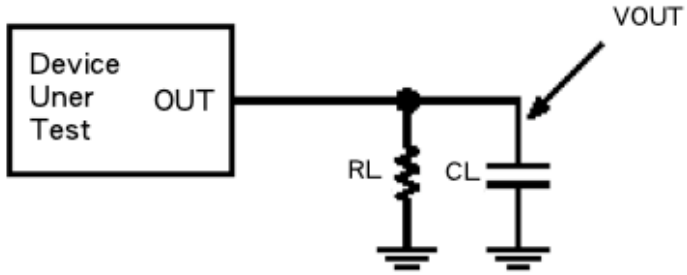
Note 2. The device is not guaranteed to function outside its operating rating.

Note 3. Devices are ESD sensitive. Handing precautions recommended.

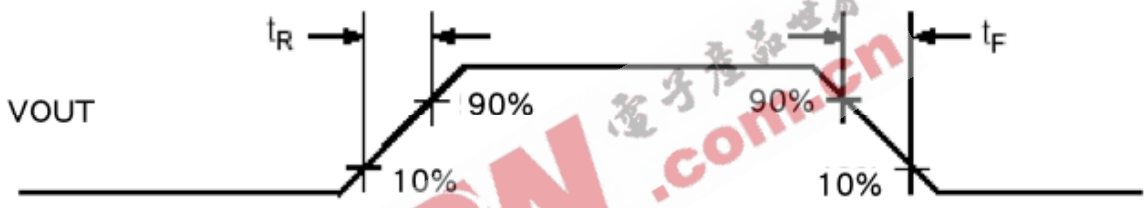
Note 4. For maintenance R_{DS}≤140mΩ assembly to make gold conductors in diameter 50m.

Note 5. If there is a fault on one channel, that channel will shut down when the die reaches approximately 140 °C. If the die reaches approximately 160 °C, both channels will shut down, even if neither channel is in current limit.

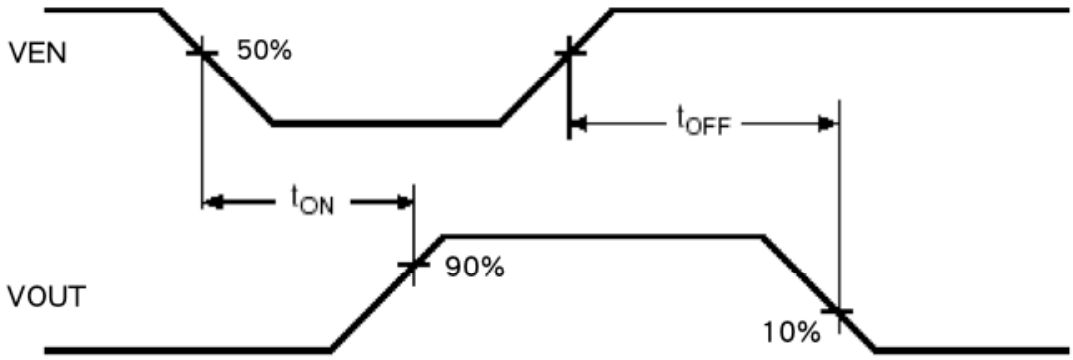
Test Circuit



Timing Diagram



Output Rise and Fall Time



Active-Low Switch Times

Function Description

Input and Output

IN is the power supply connection to the logic circuitry and the drain of the output MOSFET. OUT is the source of the output MOSFET. In a typical circuit, current flows from IN to OUT toward the load. If V_{OUT} is greater than V_{IN}, current will flow from OUT to IN, since the switch is bidirectional when enabled. The output MOSFET and driver circuitry are also designed to allow the MOSFET source to be externally forced to a higher voltage than the drain ($V_{OUT} > V_{IN}$) when the switch is disabled. In this situation, the TS2026 prevents undesirable current flow from OUT to IN.

Thermal Shutdown

Thermal shutdown is employed to protect the device from damage should the die temperature exceed safe margins due mainly to short circuit faults. Each channel employs its own thermal sensor. Thermal shutdown shuts off the output MOSFET and asserts the FLG output if the die temperature reaches 140 ^{o}C and the overheated channel is in current limit. The over channel will be shut off. Upon determining a thermal shutdown condition. The TS2026 will automatically reset its output when the die temperature cools down to 120 ^{o}C . The TS2026 output and FLG signal will continue to cycle on and off until the device is disabled or the fault is removed. Figure 1. Depicts typical timing. Depending on PCB layout, package, ambient temperature, etc., it may take several hundred milliseconds from the incidence of the fault to the output MOSFET being shut off. This time will be shortest in the case of dead short on the output.

Power Dissipation

The device's junction temperature depends on several factors such as the load, PCB layout, ambient temperature and package type. Equations that can be used to calculate power dissipation of each channel and junction temperature are found below.

$$P_D = R_{DS(ON)} \times I_{OUT}^2$$

Total power dissipation of the device will be the summation of PD for both channels. To relate this to junction temperature, the following equation can be used:

$$T_J = P_D \times \theta_{JA} + T_A$$

Where:

T_J = junction temperature

T_A = ambient temperature

θ_{JA} = is the thermal resistance of the package

Current Sensing and Limiting

The current-limit threshold is preset internally. The preset level prevents damage to the device and external load but still allows a minimum current of 500mA to be delivered to the load. The current-limit circuit senses a portion of the output MOSFET switch current. The current-sense resistor shown in the block diagram is virtual and has no voltage drop. The reaction to an over current condition varies with three scenarios.

Switch Enable into Short-Circuit

If a switch is enabled into a heavy load or short-circuit, the switch immediately enters into a constant-current mode, reducing the output voltage. The FLG signal is asserted indicating an over current condition.

Switch Enable Applied to Enabled Output

When a heavy load or short-circuit is applied to an enabled switch, a large transient current may flow until the current limit circuitry responds. Once this occurs the device limits current to less than the short circuit current limit specification.

Current-Limit Response-Ramped Load

The TS2026 current-limit profile exhibits a small fold back effect of about 200mA. Once this current-limit threshold is exceeded the device switches into a constant current mode. It is important to note that the device will supply current up to the current-limit threshold

Fault Flag

The FLG signal is an N-channel open-drain MOSFET output. FLG is asserted (active-low) when either an over current or thermal shutdown condition occurs. In the case of and over current condition, FLG will be asserted only after the flag response delay time, t_D, has elapsed. This ensured that FLG is asserted only upon valid over current conditions and that erroneous error reporting is eliminated. For example, false over current condition can occur during hot plug event when a highly capacitive load is connected and causes a high transient inrush current that exceeds the current-limit threshold for up to 1ms. The FLG response delay time t_D is typically 3ms.

Undervoltage Lockout

Undervolrage lockout (UVLO) prevents the output MOSFET from turning on until VIN exceeds approximately 2.5V. Undervoltage detection function only when the switch is enabled.

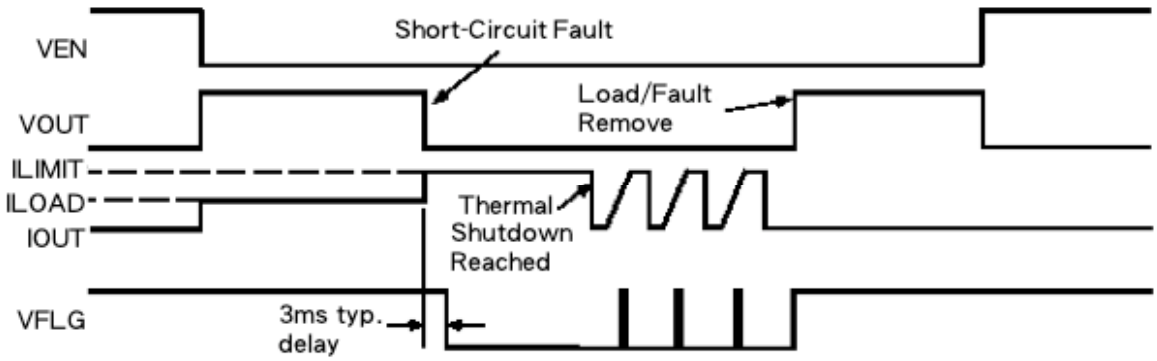
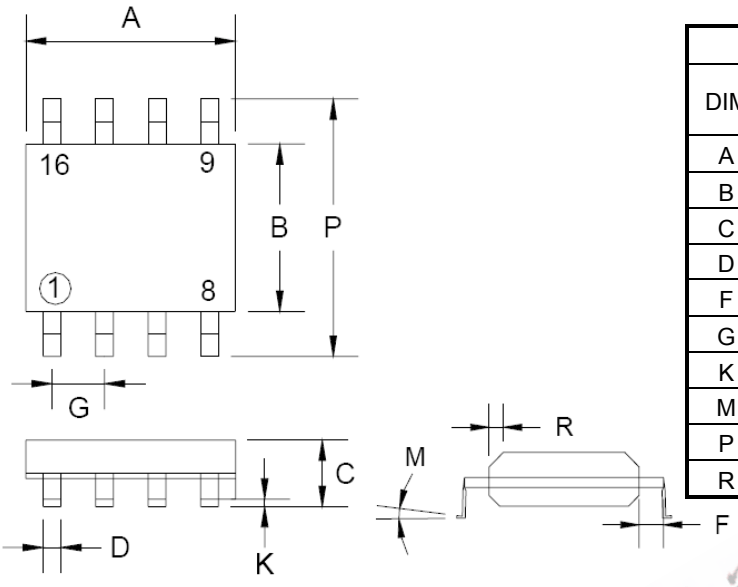


Figure 1. TS2026-L Fault Timing

SOP-8 Mechanical Drawing



SOP-8 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 (typ)		0.05 (typ)	
K	0.10	0.25	0.004	0.009
M	0^o	7^o	0^o	7^o
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019