Precision Power Distribution Switch

FEATURES

- Integrated 60mΩ Power MOSFET
- Adjustable Current Limit, 400mA to 2.4A
- Low Supply Current
- 30uA Typical at Switch On State
- 1uA Typical at Switch Off State
- Wide Input Voltage Range:2.5V to 5.5V
- Fast Transient Response:8us
- 0.1mS Typical Rise Time
- Reverse Current Flow Blocking
- Thermal Shutdown Protection
- Hot Plug-In Application (Soft-Start)
- SOT-23-5 Package

APPLICATIONS

- USB Bus/Self Powered Hubs
- Battery-Charger Circuits
- Personal Communication Devices
- Notebook Computers

GENERAL DESCRIPTION

The TMI6262AL is a cost-effective, low voltage, single P-MOSFET load switch, optimized for self-powered and bus-powered Universal Serial Bus (USB) applications. This switch operates with inputs ranging from 2.5V to 5.5V, making it ideal for both 3V and 5V systems. The switch's low RDS(ON) 60mΩ meets USB voltage drop requirements. A built-in P-channel MOSFET with true shutdown function to eliminate any reversed current flow across the switch when it is powered off. When the output voltage is higher than input voltage, the power switch is turned off by internal output reverse-voltage comparator.

The TMI6262AL offers a programmable current limit threshold between 400mA to 2.4A via an external resistor.

TYPICAL APPILCATION

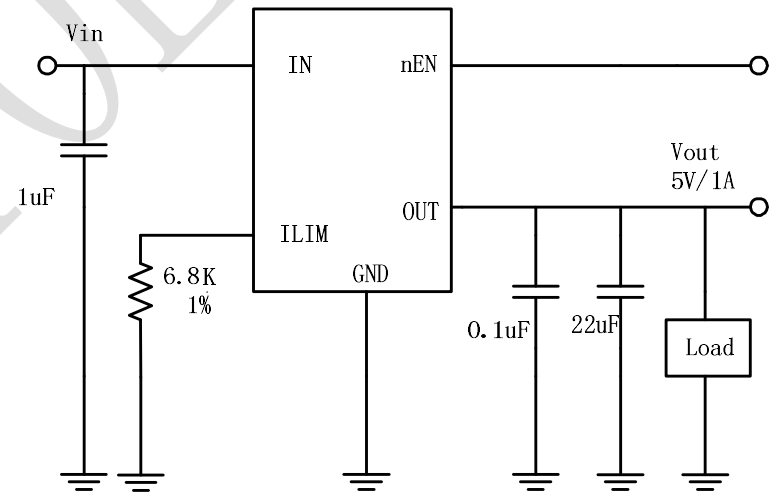
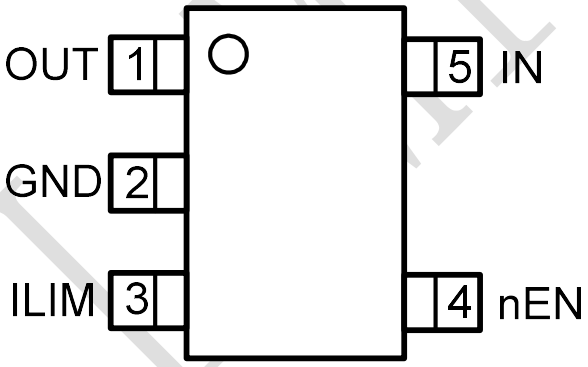


Figure 1. TMI6262AL Application Circuit

ABSOLUTE MAXIMUM RATINGS (Note 1)

Parameter	Value	Unit
Input Supply Voltage	-0.3~7	V
All other pins Voltages	-0.3~ V_{IN}+0.3	V
Junction Temperature(Note2)	-40~160	°C
Storage Temperature Range	-65~150	°C
Junction-to-ambient Thermal Resistance	260	°C/W
Junction-to-case Thermal Resistance	120	°C/W
Lead Temperature(Soldering,10s)	260	°C

PIN CONFIGURATION



SOT23-5

Top Mark: T07AXX (T07A: Device Code, XX: Inside code)

Part Number	Package	Top mark	Quantity/ Reel
TMI6262AL	SOT23-5	T07AXX	3000

PIN FUNCTIONS

Pin	Name	Function
1	OUT	Switch Output: Output MOSFET Source of switch. Typically connect to switched side of load.
2	GND	Ground Pin
3	ILIM	External resistor used to set current-limit ILIM threshold
4	nEN	Enable: Logic level enable input. Make sure EN pin never floating. Pull low to enable IC.
5	IN	Input Supply: Output MOSFET Drain, which also supplies IC's internal circuitry. Connect to positive supply.

ESD RATINGS

Items	Description	Value	Unit
V_{ESD}	Human Body Model for all pins	±2000	V

JEDEC specification JS-001

RECOMMENDED OPERATING CONDITIONS

Items	Description	Min	Max	Unit
Voltage Range	IN	2.5	5.5	V
TA	Operating Temperature Range	-40	85	°C

ELECTRICAL CHARACTERISTICS

(V_{IN}=5V , C_{IN}=1μF, C_{OUT}=1μF, T_A = 25°C.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
IN section						
V_{IN}	Input voltage		2.5		5.5	V
I_{IN_ON}	Supply current, Enable	V_{IN}=5.5V, No load on OUT		30	60	uA
I_{IN_OFF}	Shutdown current, Disable	V_{IN}=5.5V, No load on OUT		0.1	1	uA
I_{REV}	Reverse leakage current	V_{OUT}=5.5V, V_{IN}=0V		2	5	uA
V_{UVLO_ON}	Under voltage lockout exit	V_{IN} rising from 0-5V		2	2.3	V
V_{UVLO_HY}	UVLO Hysteresis			100		mV
nEN section						
V_{nEN_H}	Rising Threshold	V_{IN}=5.5V	1.5			V
V_{nEN_L}	Falling Threshold	V_{IN}=5.5V			0.8	V
I_{nEN}	EN input current	V_{EN}=5.5V	-0.5	5	10	uA
OUT section						
I_{OC}	Over Current Limit	R_{ILIM}=6.8kΩ, V_{IN}=5V	0.8	1	1.2	A
$V_{REVERSE}$	Reverse voltage protection	V_{OUT}-V_{IN}	5	20	50	mV
T_{RISE}	Output rise time	CL=1uF, RL=100ohm		0.1		ms
T_{FALL}	Output fall time	CL=1uF, RL=100ohm		0.3		ms
T_{IOS}	Response time to short circuit			12		us
Power switch						
R_{DS_ON}		I_{OUT}=1A		60		mΩ

Thermal Shutdown						
T_{NORMAL}	Thermal shutdown temperature			150		℃
T_{NORMAL_HY}	Thermal shutdown hysteresis			20		℃

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: TJ is calculated from the ambient temperature TA and power dissipation PD according to the following formula: TJ = TA + (PD) x (250°C/W).

Note3: 100% production test at + 25°C. Specifications over the temperature range are guaranteed by design and characterization.

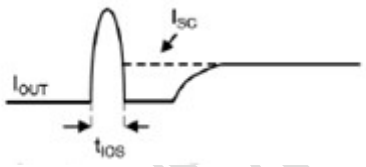


Figure 2

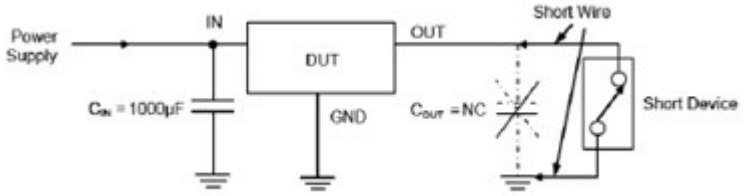


Figure 3

Note:

To exactly identify the short circuit characteristic of IC, avoid the test result interfered by parasitic inductor, output capacitor, and contact resistor. It is necessary to follow the recommendation as follows.

Please,

1. Add 1000µF of capacitor between VIN and GND, and close to IC.
2. Remove output capacitor.
3. Shorter the short circuit device wire.
4. Measure output current (IOUT).

FUNCTIONAL BLOCK DIAGRAM

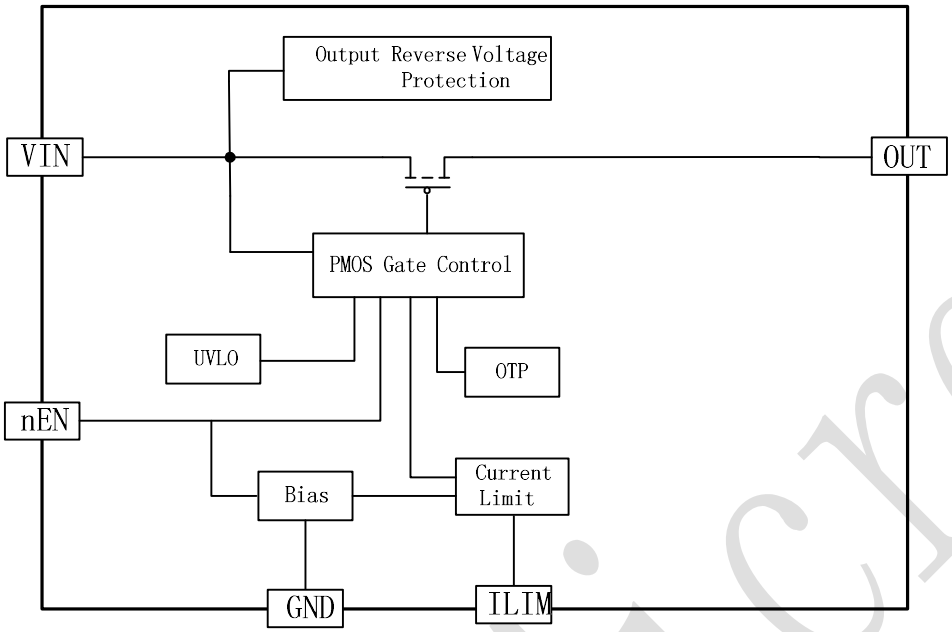
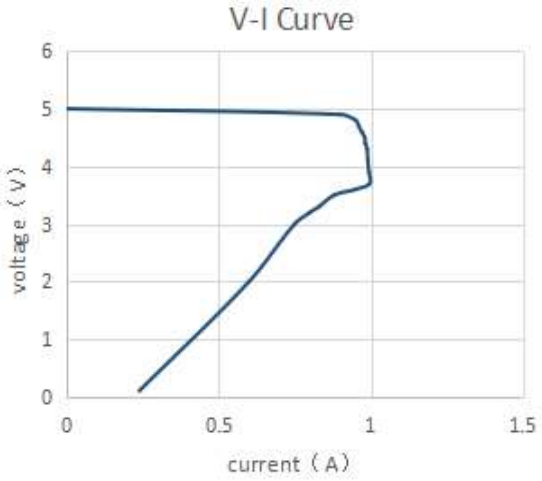


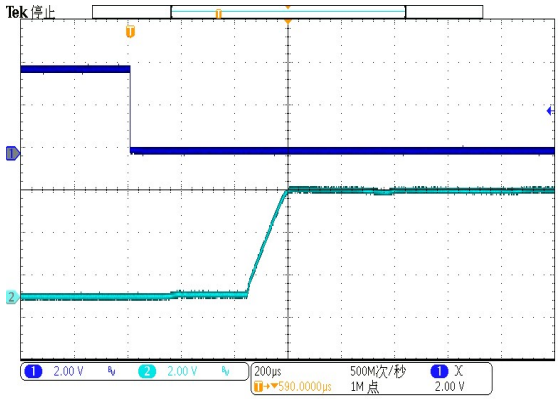
Figure 4. TMI6262AL Block Diagram

TYPICAL PERFORMANCE CHARACTERISTICS

Over current Protection Characteristics

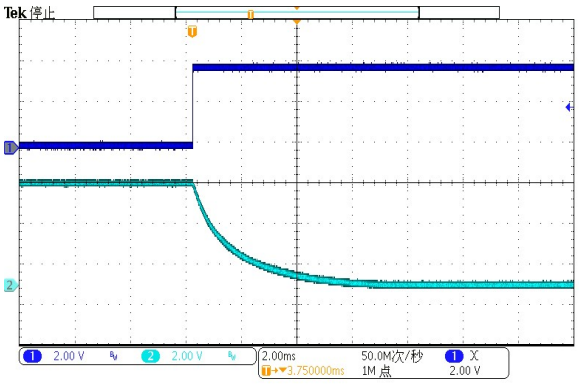


Turn on Delay Time and Rise Time



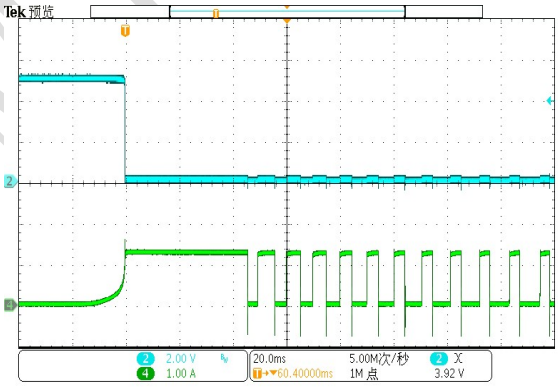
CH1:EN CH2:V_{OUT} 200uS/div

Turn off Delay Time and Fall Time



CH1:EN CH3:VOUT 2mS/div

Short Circuit Response



CH2:VOUT CH4:IOUT 20mS/div

APPLICATION INFORMATION

The TMI6262AL is current-limited, power distribution switches using P-channel MOSFETs for applications where short circuits or heavy capacitive loads will be encountered and provide up to 2.4 A of continuous load current. Additional device shutdown features include over temperature protection and reverse-voltage protection. The driver controls the gate voltage of the power switch. The driver incorporates circuitry that controls the rise and fall times of the output voltage to limit large current and voltage surges and provides built-in soft-start functionality. The TMI6262AL enters constant current mode when the load exceeds the current-limit threshold.

Input and Output

IN (input) is the power supply connection to the logic circuitry and the drain of the output MOSFET. OUT(output) is the source of the output MOSFET. In a typical application, current

flows through the switch from IN to OUT toward the load. OUT pin must be connected together to the load.

Soft Start for Hot Plug-In Applications

In order to eliminate the upstream voltage droop caused by the large inrush current during hot-plug events, the “soft-start” feature effectively isolates the power source from extremely large capacitive loads, satisfying the USB voltage droop requirements.

Setting Current Limit

The over-current threshold is user programmable via an external resistor. The TMI6262AL use an internal regulation loop to provide a regulated voltage on the ILIM pin. The current-limit threshold is proportional to the current sourced out of ILIM. The recommended 1% resistor range for RILIM is 2.5kΩ ≤ RILIM ≤17kΩ to ensure stability of the internal regulation loop. Many applications require that the minimum current limit is above a certain current level or that the maximum current limit is below a certain current level, so it is important to consider the tolerance of the over current threshold when selecting a value for RILIM. The following Figure 6 can be used to select the resulting type over-current threshold for a given external resistor value (RILIM).

$$I_{LIMT}=6800/R_{ILIM}$$

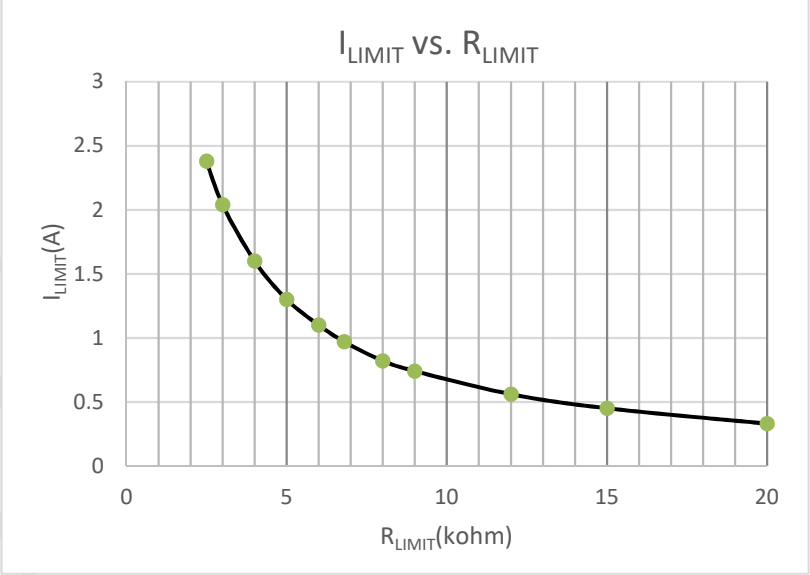


Figure 6. I_{LIMIT} vs. R_{LIMIT}

Thermal Considerations

The TMI6262AL protects itself with two independent thermal sensing circuits that monitor the operating temperature of the power-switch and disables operation if the temperature exceeds recommended operating conditions. The device operates in constant-current mode during an over-current conditions, which increases the voltage drop across power-switch.

The power dissipation in the package is proportional to the voltage drop across the power-switch, so the junction temperature rises during an over-current condition. The first thermal sensor turns off the power-switch when the die temperature exceeds 130°C and the part is in current limit. The second thermal sensor turns off the power-switch when the die temperature exceeds 150°C regardless of whether the power-switch is in current limit. Hysteresis is built into both thermal sensors, and the switch turns on after the device has cooled approximately 20°C(Thermal shutdown threshold hysteresis in current-limit is 20°C). The switch continues to cycle off and on until the fault is removed. The open-drain is asserted (active low) immediately during an over temperature shutdown condition.

nEN，the Enable Input

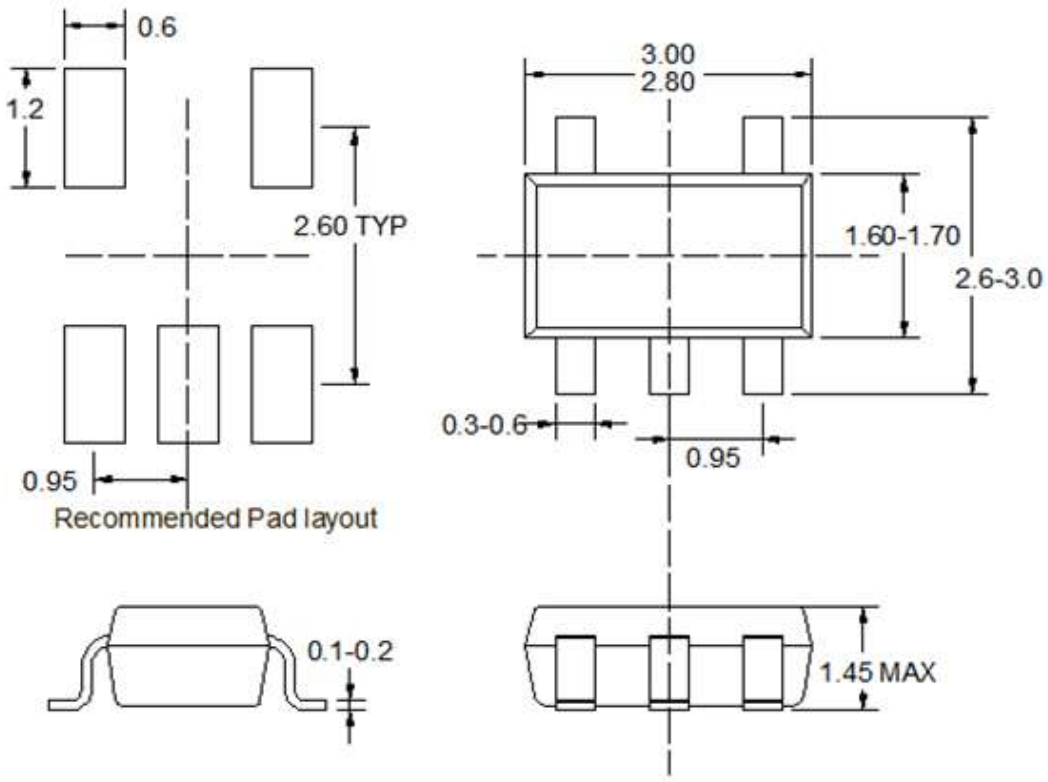
nEN must be driven logic high or logic low for a clearly defined input. Floating the input may cause unpredictable operation.

Layout Consideration

For best performance of the TMI6262AL, the following guidelines must be strictly followed.

- Input and output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.
- The GND should be connected to a strong ground plane for heat sink.
- Keep the main current traces as possible as short and wide.

PACKAGE INFORMATION



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