70mΩ Current-Limited, Power-Distribution Switches

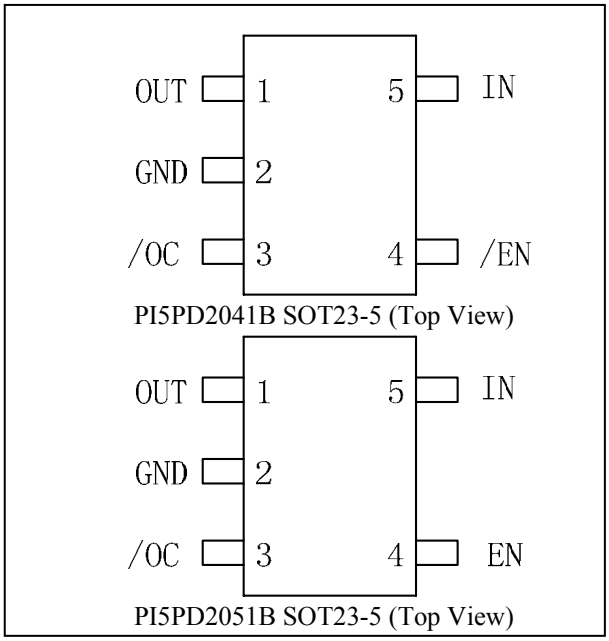
Features

- 70mΩ High-Side MOSFET
- 1A Continuous Current
- Thermal and Short-Circuit Protection
- Accurate Current Limit (1.5A typ.)
- Operating Range: 2.7V to 5.5V
- 0.6ms Typical Rise Time
- Under-Voltage Lockout
- Deglitched Fault Report (/OC)
- 1μA Maximum Standby Supply Current
- Reverse Current Blocking
- Ambient Temperature Range: -40°C to 85°C

Applications

- Laptop, Motherboard PC
- USB Bus/Self Powered Hubs
- TV and Set-top BOX Power switch
- USB Peripherals
- Battery-Powered Equipment
- Hot-Plug Power Supplies

Pin Configuration



PI5PD2041B SOT23-5 (Top View)

PI5PD2051B SOT23-5 (Top View)

Description

The PI5PD2041B/51B is an integrated 70mΩ N-channel MOSFET power switches for self-powered and bus-powered Universal Series Bus (USB) applications. The devices are equipped with charge pump circuitry to drive the internal MOSFET switch. The switch's low $R_{DS(on)}$, 70mΩ meets USB voltage drop requirements. This power-distribution switch is designed to set current limit at 1.5A typically.

When the output load exceeds the current-limit threshold or a short-circuit situation is present, the devices limit the output current by switching into a constant-current mode, pulling the over-current (/OC) logic output low. When continuous heavy overloads and short-circuits increase the power dissipation in the switch, causing the junction temperature to rise, a thermal protection circuit turns off the switch to prevent damage. Recovery from a thermal shutdown is automatic once the device has cooled sufficiently. Internal circuitry ensures that the switch remains off until valid input voltage is present..

Pin Description

Pin No.	Pin	Type	Description
2	GND	-	Ground.
5	IN	I	Power Input Voltage.
4	/EN (PI5PD2041B)	I	Chip Enable, logic low turns on power switch.
4	EN (PI5PD2051B)	I	Chip Enable, logic high turns on power switch.
3	/OC	O	Over current, open-drain output, active-low.
1	OUT	O	Power Output Voltage

Function comparison table

Part Number	Enable	Recommended maximum continuous load current	Typical short circuit current limit at 25ºC	Number of switch
PI5PD2041B	Active Low	1A	1A	Single
PI5PD2051B	Active High			Single

Maximum Ratings

Storage Temperature ..... -65°C to +150°C
Operating virtual junction temperature range, T_J ..... -40°C to +125°C
Input Voltage range ($V_{I(IN)}$ [2]) ..... -0.3V to +6V
Output Voltage range ($V_{O(OUT)}$ [2]) ..... -0.3V to +6V
Input Voltage range ($V_{I(EN)}$, $V_{I(EN)}$) ..... -0.3V to +6V
Voltage range ($V_{I(OC)}$, $V_{I(OC)}$) ..... -0.3V to +6V
Continuous output current ($I_{O(OUT)}$) ..... Internally limit
Power Dissipation SOT23-5/400mW
Electrostatic discharge (ESD) protection ..... 4kV/Human body MIL-STD-883C
Electrostatic discharge (ESD) protection ..... 500V/Charge device model(CDM)

Note:
(1)Stresses greater than those listed under MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
(2)All voltages are with respect to GND.

Recommended Operating Conditions

Symbol	Description	Min	Type	Max	Unit
$V_{I(IN)}$	Input Voltage	2.7	-	5.5	V
$V_{I(EN)}$, $V_{I(EN)}$	Input Voltage	0	-	5.5	V
$I_{O(OUT)}$	Continuous Output Current	0	-	1	A
T_J	Operating Virtual Junction Temperature Range	-40	-	125	ºC

Electrical Characteristics

Unless otherwise specified, $V_{I(IN)}$ = 5.5V, I_O = 1.0A, $V_{I(EN)}$ = 0V, $V_{I(EN)}$ = 5.5V.

Sym	Description	Test Conditions[1]		Min	Typ	Max	Unit
Power Switch							
$R_{DS(on)}$	Static drain-source on-state resistance, 5V operation and 3.3V operation	$V_{I(IN)}$ = 5V or 3.3V, I_O = 1.0A, -40°C ≤T_J≤ 125°C		-	70	135	mΩ
	Static drain-source on-state resistance, 2.7V operation[2]	$V_{I(IN)}$ = 2.7V, I_O = 1.0A, -40°C ≤T_J ≤ 125°C		-	75	150	mΩ
t_r [2]	Rise time, output	$V_{I(IN)}$ = 5.5V	C_L=1μF, R_L=10Ω, T_J =25°C	-	0.6	1.5	ms
		$V_{I(IN)}$ = 2.7V		-	0.4	1	
t_f [2]	Fall time, output	$V_{I(IN)}$ = 5.5V		0.05	-	0.5	
		$V_{I(IN)}$ = 2.7V		0.05	-	0.5	
Enable Input /EN or EN							
V_{IH}	High-level input voltage	2.7 V ≤ $V_{I(IN)}$ ≤ 5.5 V		2	-	-	V
V_{IL}	Low-level input voltage	2.7 V ≤ $V_{I(IN)}$ ≤ 5.5 V		-	-	0.8	
I_I	Input current	$V_{I(/EN)}$ = 0 V or 5.5 V		-0.5	-	0.5	μA
t_{on} [2]	Turn on time	C_L = 100μF, R_L = 10Ω		-	-	3	ms
t_{off} [2]	Turn off time	C_L = 100μF, R_L = 10Ω		-	-	10	
Current Limit							
I_{OS}	Short-circuit output current	$V_{I(IN)}$ =5V, OUT connected to GND, device enabled into short-circuit	T_J =25°C	0.75	1	1.25	A
			-40°C ≤T_J ≤ 125°C	0.7	1	1.3	
$I_{OC-TRIP}$	Overcurrent trip threshold	$V_{I(IN)}$=5V, current ramp (≤100 A/s) on OUT		1.1	1.5	2.5	A
Supply Current							
I_{STB}	Input supply current at output disable	No load on OUT, $V_{I(/EN)}$= 5.5V, or $V_{I(EN)}$=0V	T_J =25°C	-	0.1	-	μA
			-40°C ≤T_J ≤ 125°C	-	0.2	-	
I_{SS}	Input supply current at output enable	No load on OUT, $V_{I(/EN)}$ = 0V, or $V_{I(EN)}$ = 5.5V	T_A=25°C	-	43	-	
			-40°C ≤T_J ≤ 125°C	-	43	-	
	Leakage current	OUT connected to ground, $V_{I(/EN)}$ = 5.5V, or $V_{I(EN)}$ = 0V	-40°C ≤T_J ≤ 125°C	-	1	-	
	Reverse leakage current	$V_{I(OUT)}$=5.5V, IN= ground[2]	T_J =25°C	-	0.1	-	

To be continued.

Continuously.						
Sym	**Description**	**Test Conditions(1)**	**Min**	**Typ**	**Max**	**Unit**
Under-voltage Lockout						
	Low-level input voltage, IN	-	2	-	2.5	V
	Hysteresis, IN	T_J =25°C	-	75	-	mV
Overc-urrent /OC						
	Output low voltage, $V_{OL(/OC)}$	$I_{O(/OC)}$ = 5mA	-	-	0.4	V
	Off-state current(2)	$V_{O(/OC)}$ = 5V or 3.3V	-	-	1	μA
	/OC deglitch(2)	/OC assertion or de-assertion	4	12	15	ms
Thermal Shutdown(3)						
	Thermal shutdown threshold(2)	-	135	-	-	°C
	Recovery from thermal shutdown(2)	-	125	-	-	°C
	Hysteresis(2)	-	-	10	-	°C

Note:

(1) Pulse-testing techniques maintain junction temperature close to ambient temperature; thermal effects must be taken into account separately.

(2) Not tested in production, specified by design.

(3) The thermal shutdown only reacts under over current conditions.