High-Current Over-voltage Protector with Digital Signal Transmission

General Description

ET9543 can disconnect the systems from its output pin (OUT) in case wrong input operating conditions are detected. The system is positive over-voltage protected up to 29V. The internal over-voltage threshold(OVLO) is 5.8V. ET9543 has internal thermal shutdown Protection and Input Voltage detection. And ET9543 internal switch supports 10Mbps digital signal communication when V_{IN}=0V and powered by VDD pin.

The device is packaged in advanced full-Green compliant Wafer Level Chip Scale Packaging (WLCSP6).

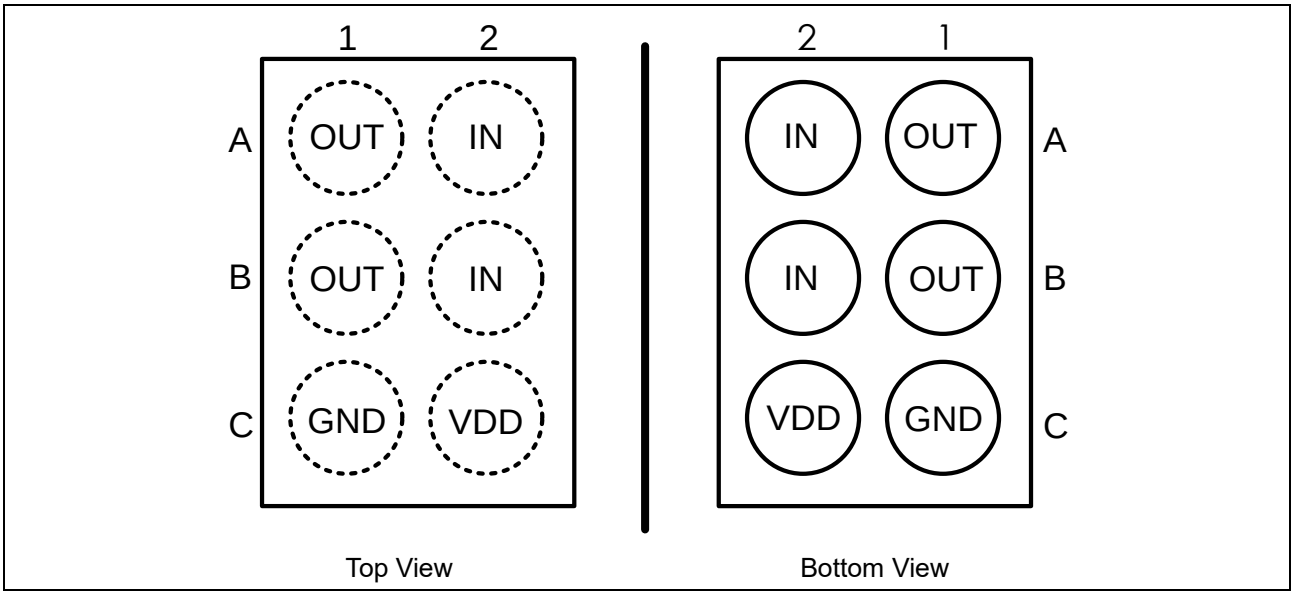
Features

- 4A Continuous Current Capability
- Typical R_{ON}: 22mΩ N-Channel MOSFET
- V_{IN} Operating Range: 2.7V to 29V
- Over-Voltage Protection (OVP) Threshold: 5.8V (TYP)
- Over-Voltage Protection Response Time: 50ns (TYP)
- Support 10Mbps Communication
- Internal Thermal-Shutdown Protection
- ESD Protection
  -- HBM ESDA/JEDEC JS-001-2023 Exceeds ±2KV
  -- CDM ESDA/JEDEC JS-002-2022 Exceeds ±1.5KV
- WLCSP6 Package (ball pitch=0.4mm)

Application

- Smartphones, Tablet PC, TWS
- HDD, Storage and Solid State Memory Devices
- Portable Media Devices, Laptop & MID
- SLR Digital Cameras
- GPS and Navigation Equipment
- Industrial Handheld and Enterprise Equipment

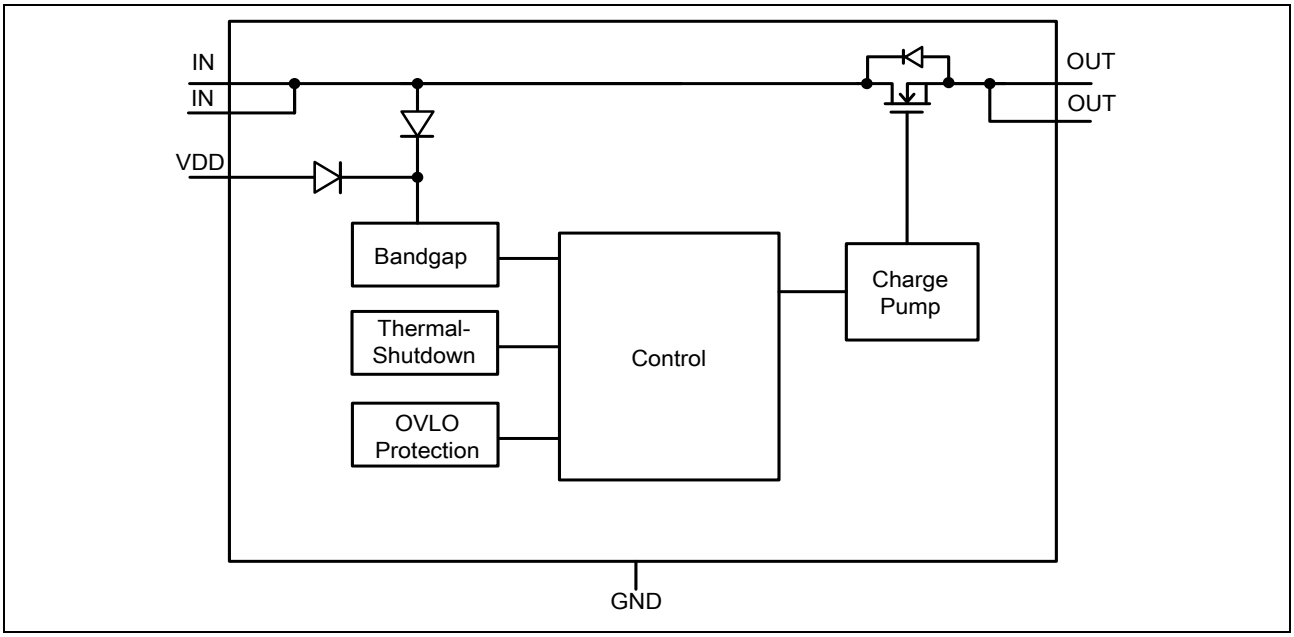
Pin Configuration



Pin Function

Pin	Name	Description
A1、B2	OUT	Output Voltage. Output of internal switch. Connect OUT pins together for proper operation.
A2、B2	IN	Voltage Input. Connect IN pins together for proper operation.
C1	GND	Ground. Connect GND pins together for proper operation.
C2	VDD	VDD Power Supply. Connect to system GPIO for communication function.

Block Diagram



Functional Description

The OVP switch with over-voltage protection feature a low 22mΩ (TYP.) on-resistance (R_{ON}) internal FET and protect low-voltage systems against voltage faults up to 29VDC. If the input voltage (V_{IN}) exceeds 5.8V, the internal FET is quickly turned off to prevent damage to the protected downstream components.

ET9543 internal switch feature 10Mbps digital signal communication when V_{IN}=0V and powered by VDD pin.

Communication Functionality

Both IN and VDD may supply ET9543. ET9543 would compare the voltage between IN and VDD, and select the higher voltage to power the IC. By this way, ET9543 supports digital signal transmission through IN and OUT when V_{IN}=0V and the device is powered by VDD. Typically, VDD is recommended to be driven by GPIO. For example, V_{VDD}=3.0V would power ET9543 even when V_{IN}=0V. It is necessary to remove input and output capacitor when communication is required.

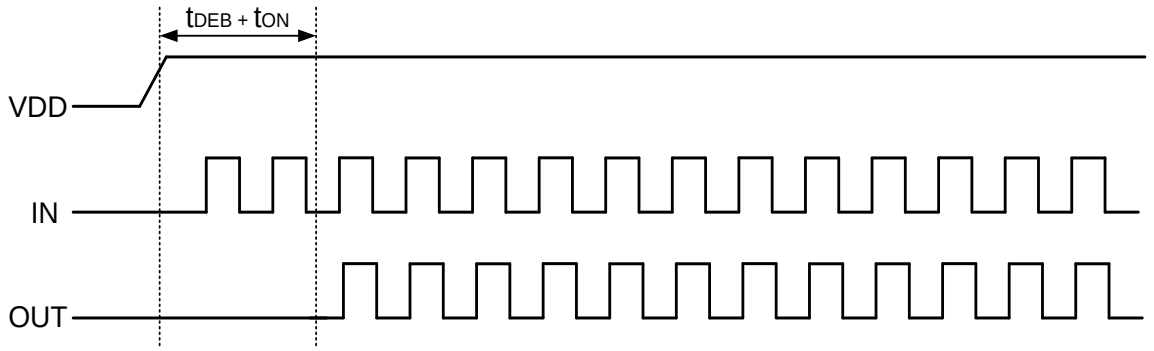


Figure 1. Timing for V_{IN} communication

Thermal Protection

The internal FET turns off when the junction temperature exceeds +150°C (TYP.). The device exits thermal shutdown after the junction temperature cools by 20°C (TYP.).

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameters		Min	Max	Unit
V_{IN}	IN to GND		-0.3	31	V
V_{OUT}	OUT to GND		-0.3	V_{IN}+0.3V	V
V_{VDD}	VDD to GND		-0.3	6	V
I_{SW1}	Maximum Continuous Current of switch IN-OUT			4	A
I_{SW2}	Maximum Peak Current of switch IN-OUT(10ms)			6	A
P_D	Power Dissipation at T_A= +70°C			1000	mW
T_{STG}	Storage Junction Temperature		-65	+150	°C
T_A	Operating Temperature Range		-40	+85	°C
T_L	Soldering Temperature (reflow).			+260	°C
T_{JMAX}	Max Junction Temperature			+150	°C
ESD	IEC 61000-4-2 System Level ESD	Air Discharge	15.0		KV
		Contact Discharge	8.0		
	Human Body Model, ESDA/JEDEC JS-001-2023	All Pins	⩾2.0		
	Charged Device Model, ESDA/JEDEC JS-002-2022	All Pins	⩾1.5		

Electrical Characteristics

Unless otherwise noted, typical values are at V_{IN}=5V and T_A=25°C.

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
Basic Operation						
V_{IN}	Input Voltage		2.7		29	V
V_{IN_VDD}	VDD Supply Voltage for Communication Transmission		1.6		5.5	V
I_{IN}	V_{IN} Quiescent Current	V_{IN}=5V, OUT floating		70		μA
I_{IN_VDD}	VDD Quiescent Current for Communication Transmission	V_{OVLO}=1.8V		30		
R_{ON}	On-Resistance of Switch IN-OUT	V_{IN}=5V, I_{OUT}=1A		22	40	mΩ
V_{OVLO}	Over-voltage Protect of V_{IN}		5.6	5.8	6.0	V
V_{UVLO}	Under Voltage Lockout Threshold	V_{IN} Rising		2.3		V
		V_{IN} Falling		2.1		V
T_{SD}(1)	Thermal Shutdown			150		ºC
T_{SD_HYS}(1)	Thermal-shutdown Hysteresis			20		ºC
Dynamic Characteristics						
t_{DEB}	Debounce Time	Time from V_{IN}<V_{OVLO} to V_{OUT}=10% of V_{IN}		15		ms
t_{ON}	Switch Turn-On Time	V_{IN}=5V, R_L=100Ω, C_L=100uF, V_{OUT} from 0.1×V_{IN} to 0.9×V_{IN}		0.5		ms
t_{OFF_RES}(1)	Switch Turn-off Response Time	V_{IN} > V_{OVLO} to V_{OUT} stop rising		50		ns

Note1： Guaranteed by characterization and design.

Timing Waveform

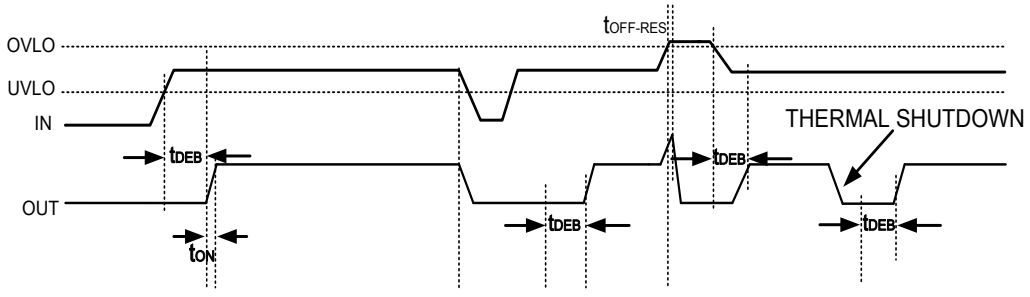
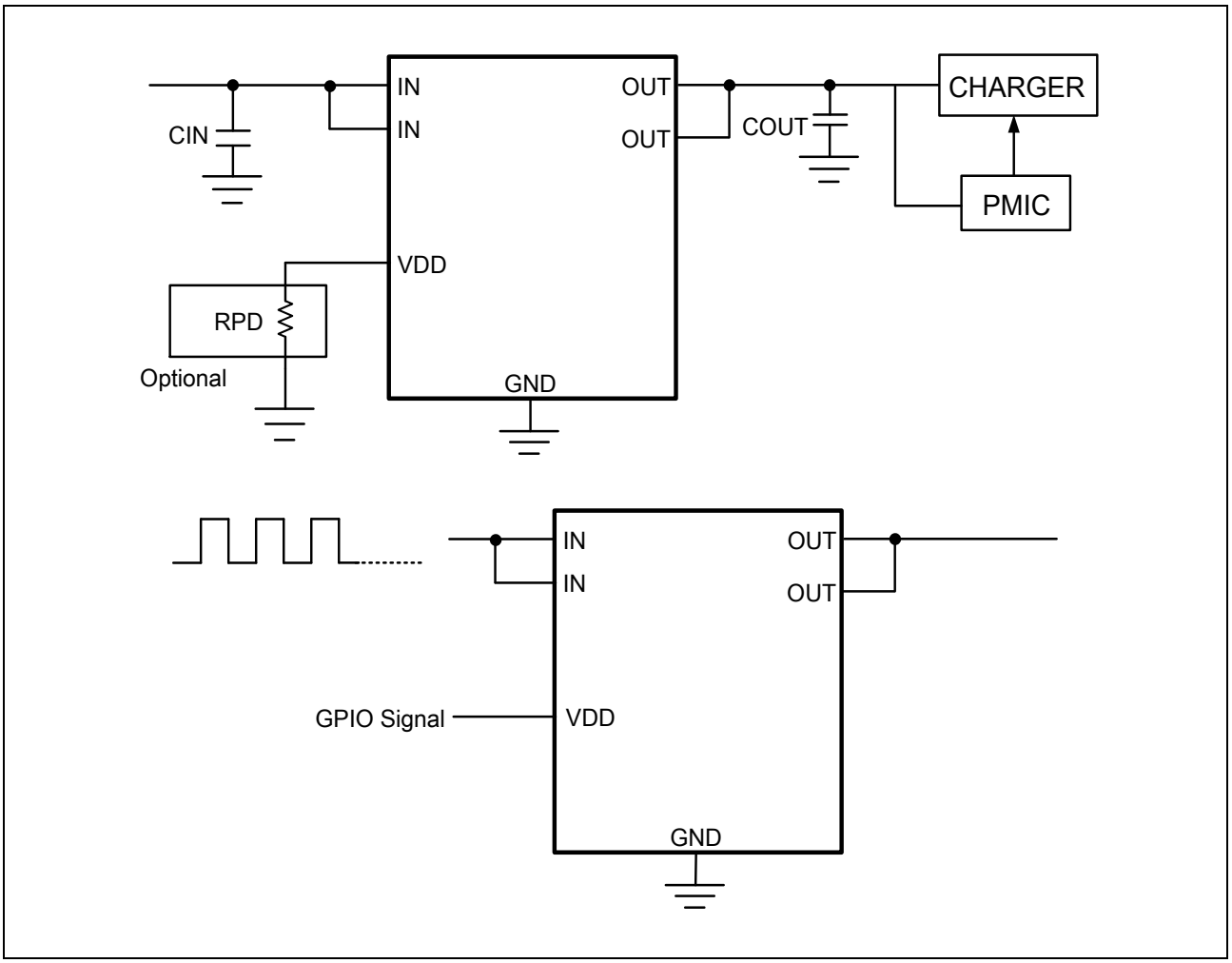


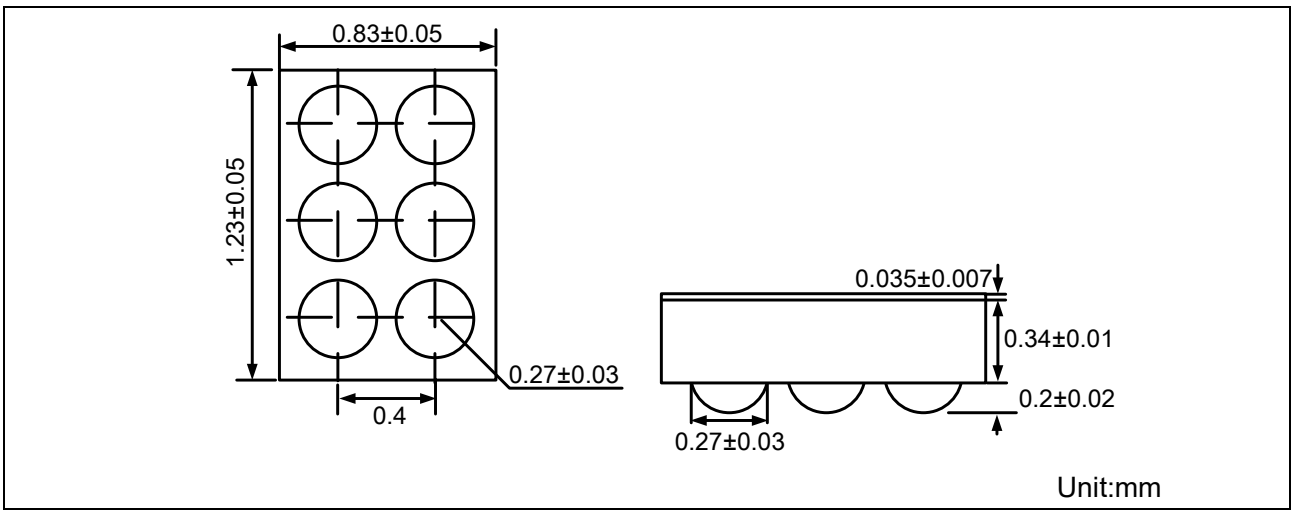
Figure 2.Timing for V_{IN} Power ON

Application Circuits

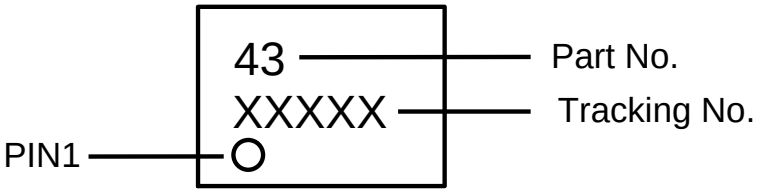


Note：This electric circuit only supplies for reference.

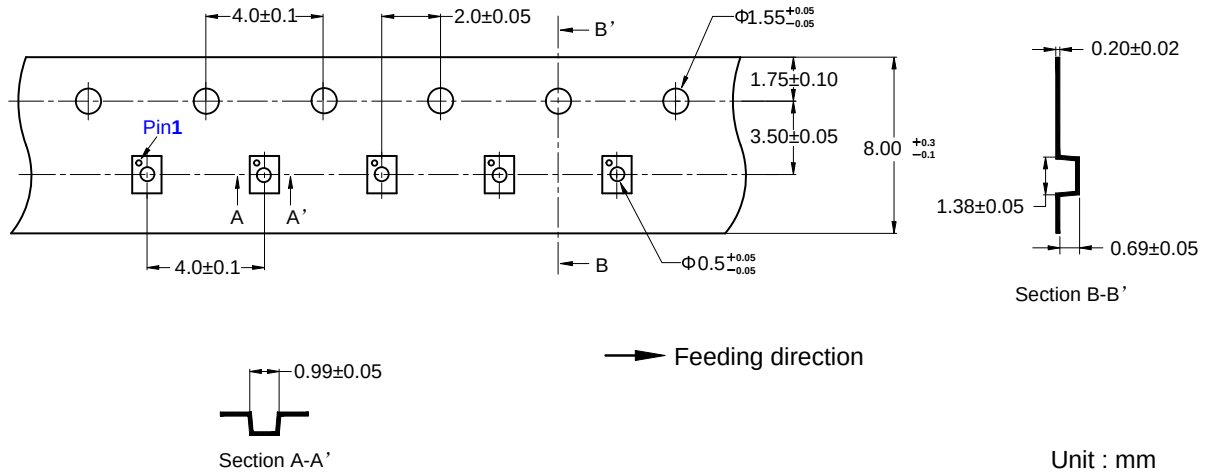
Package Dimension



Marking



Tape Information



Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
0.0	2023-10-31	Preliminary Version	Wum	Wuhs	Wuhs
0.1	2023-11-01	Preliminary Version	Wum	Wuhs	Wuhs
1.0	2025-01-03	Initial Version	Caojc	Wum	Wuhs