Over-Voltage Protector Load Switch

General Description

ET9613 is an Over-Voltage-Protection (OVP) load switch with fixed OVLO threshold voltage. The OVLO threshold voltage is fixed 6.0V. The system is positive over-voltage protected up to 32V. ET9613 has over current protection, internal thermal shutdown protection and input voltage detection.

ET9613 series are offered DFN8(2.0mm × 2.0mm) and SOT23-6 packages.

Features

- 1.5A Continuous Current Capability
- Typical R_{ON}: 200mΩ N-Channel MOSFET
- V_{IN} Operating Range: 3.5V to 32V
- Over-Voltage Protection (OVP) threshold: 6.0V (TYP), ±3%
- Over-Voltage Protection Response Time: 50ns (TYP)
- Internal Thermal-Shutdown Protection
- Programmed Over-Current Protection, 0.1A to 2.0A, ±10%
- ESD Protected:

  -- Human Body Model (JS-001-2024) All Pins ±2KV Pass

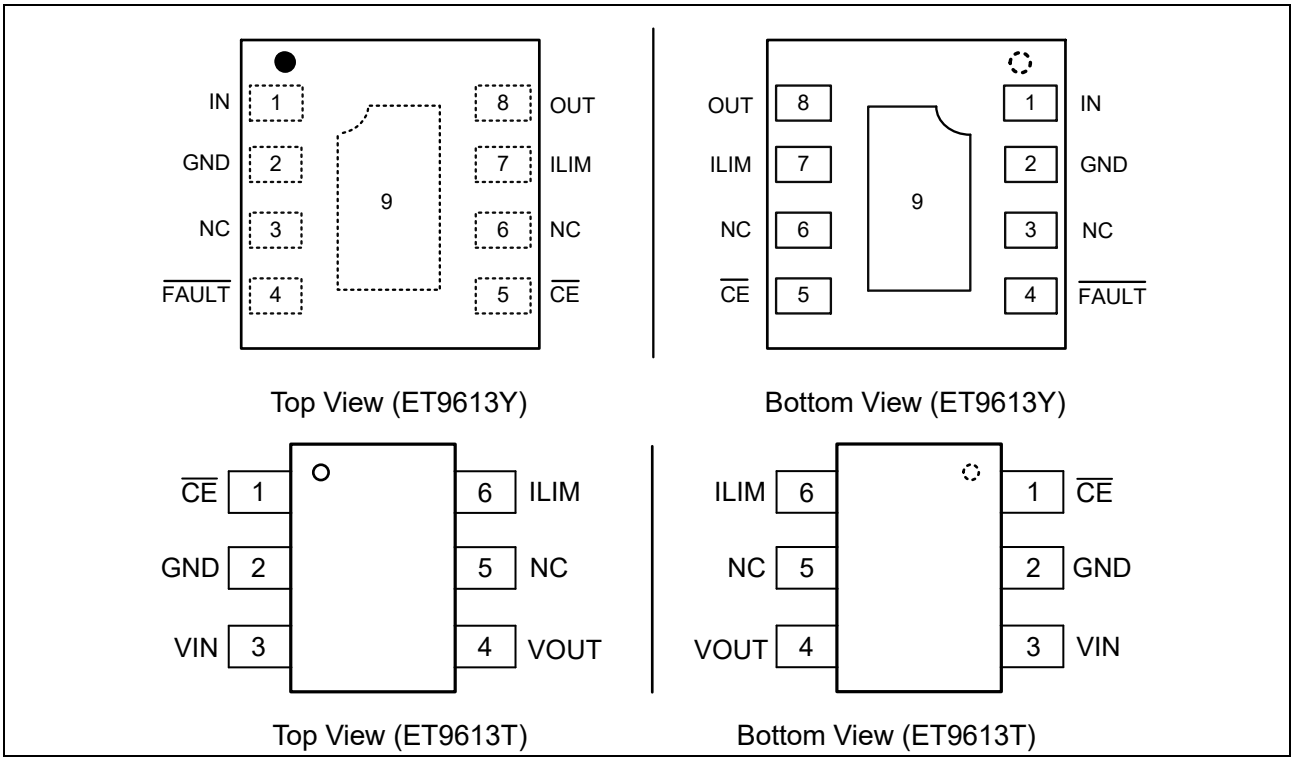
  -- Charged Device Model (JS-002-2022) All Pins ±1.5KV Pass
- Package Information:

Part No.	Package	Packing Option	MSL
ET9613Y	DFN8 (2.0mm × 2.0mm)	Tape and Reel, 3K/Reel	1
ET9613T	SOT23-6	Tape and Reel, 3K/Reel	3

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

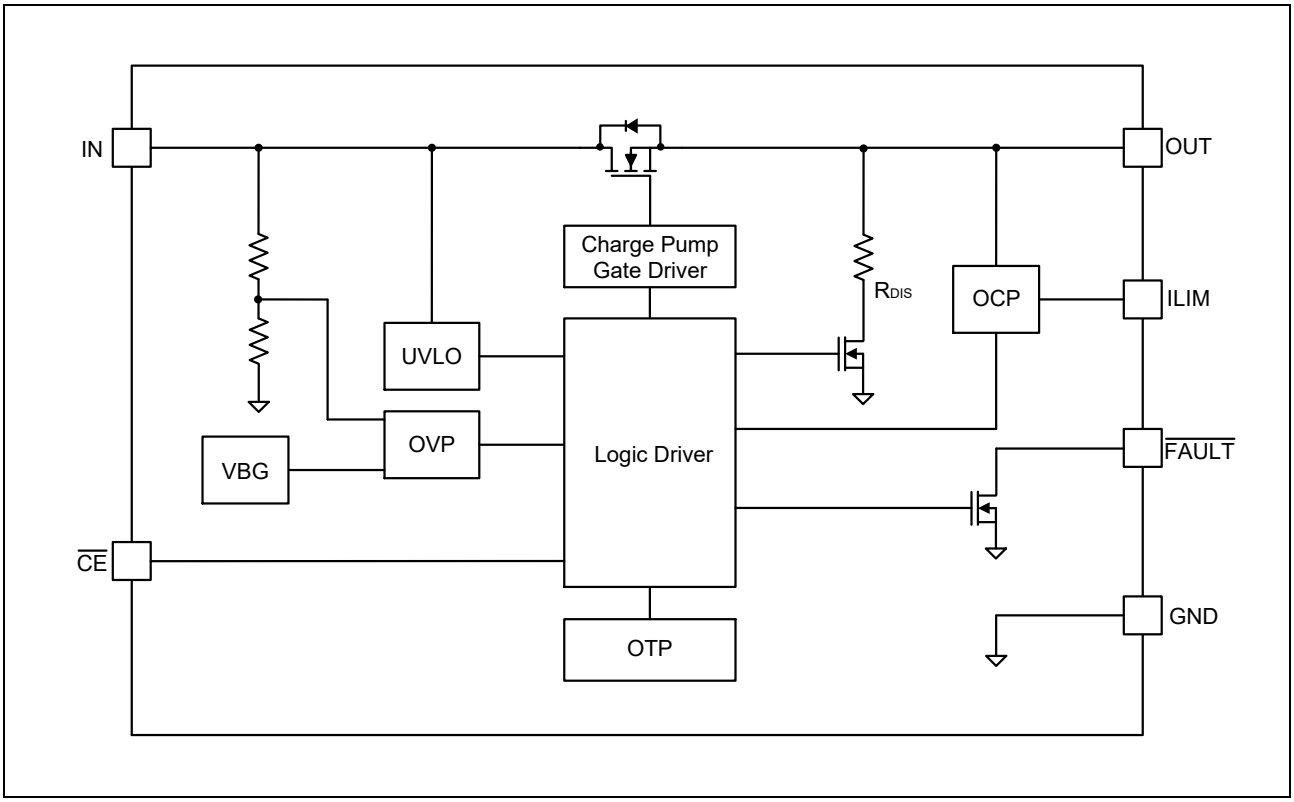
Pin Configuration



Pin Function

ET9613Y	ET9613T	Pin Name	Description
1	3	IN	Voltage Input.
2	2	GND	Ground.
3,6	5	NC	No Connected.
4	/	$\overline{\text{FAULT}}$	Open-drain Device Status Output. $\overline{\text{FAULT}}$ is pulled to GND with a 1kΩ resistant internally when the input pass FET has been turned off due to input over-voltage or overload current protection, an over-temperature condition, or because the battery voltage is outside safe limits. $\overline{\text{FAULT}}$ is high impedance during normal operation.
5	1	$\overline{\text{CE}}$	Active-Low Chip Enable Input. Connect $\overline{\text{CE}}$ = “HIGH” to turn the input pass FET off.Connect $\overline{\text{CE}}$ = “LOW” to turn the internal pass FET on, connecting the input to the charging circuitry. $\overline{\text{CE}}$ is internally pulled down.
7	6	ILIM	Current Limit Set Pin. Connect a resistor to GND to set over current threshold. I_{LIM}=600/R_{ILIM}. (Current in A, resistance in Ω). Short ILIM to GND will disable current limitation.
8	4	OUT	Voltage Output. Output of internal switch.
9	/	/	Exposed Pad for heat dissipating, it is must to connect GND.

Block Diagram



Functional Description

The OVP switch with over-voltage protection feature a 200mΩ (TYP.) on-resistance (R_{ON}) internal FET and protect low-voltage systems against voltage faults up to 32V DC. If the input voltage (V_{IN}) exceeds 6.0V, the internal FET is quickly turned off to prevent damage to the protected downstream components.

Over Current Protection(OCP)

The Over Current threshold can adjustable by a external resistor connected from the ILIM pin to GND. The OCP threshold is calculated using Equation 1:

$$I_{ILIM} = \frac{600}{R_{ILIM}} \quad (1)$$

- Current in A, resistance in Ω.

If the output current exceeds the I_{OCP} threshold and over current condition lasts longer than exceeds the 1ms, the switch will be turned off. The ET9613 enters hiccup mode. The switch will re-soft start again after 2.5s.

When short ILIM to GND, the normal current limit function is disabled.

Over-Voltage Lockout (OVLO)

When V_{IN} exceeds the OVP threshold voltage, the over-voltage lockout (OVLO) circuit turns off the protected power switch.

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	34	V
V_{OUT}	OUT to GND		-0.3	7	V
V_{ILIM}	ILIM to GND		-0.3	6	V
$V_{\overline{FAULT}}$	$\overline{FAULT}$ to GND		-0.3	6	V
$V_{\overline{CE}}$	$\overline{CE}$ to GND		-0.3	6	V
I_{SW1}	Maximum Continuous Current of switch IN-OUT			1.5	A
I_{SW2}	Maximum Peak Current of switch IN-OUT(10ms)			2.0	A
P_D	Power Dissipation at T_A= +25°C			1.0	W
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 Capacity	Human Body Model, ANSI/ESDA/JEDEC JS-001-2024	All Pins	-2.0	+2.0	KV
	Charged Device Model, JS-002-2022	All Pins	-1.5	+1.5	

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	3.5	32	V
I_{SW}	Maximum Continuous Current of Switch IN-OUT		1.5	A
I_{OCP}	Limit Current	0.1	2.0	A
R_{ILIM}	OCP Programming Resistor	300	6000	Ω
T_A	Operating Temperature Range	-40	+85	°C

Electrical Characteristics

Unless otherwise noted, typical values are at V_{IN}=5V,C_{IN}=C_{OUT}=1μF and T_A=25°C.

Symbol	Parameters	Conditions	Min	Typ	Max	Unit
Basic Operation						
V_{IN}	Input Voltage		3.5		32	V
I_{IN}	V_{IN} Quiescent Current	V_{IN}=5V, OUT floating，$\overline{CE}$=GND		70		μA
I_{IN_OVLO}	Over-Voltage Quiescent Current	V_{IN}=30V, OUT floating，$\overline{CE}$=GND		150		μA
R_{ON}	On-Resistance of Switch IN-OUT	V_{IN}=5V, I_{OUT}=500mA		200		mΩ
V_{OVLO}	Over-Voltage Protect of V_{IN}	V_{IN} Rising	5.82	6.0	6.18	V
		V_{IN} Falling		5.75		
$V_{\overline{CE}_R}$	$\overline{CE}$ High Threshold Voltage	V_{IN}=5V	1.4			V
$V_{\overline{CE}_F}$	$\overline{CE}$ Low Threshold Voltage	V_{IN}=5V			0.4	V
V_{UVLO}	Under Voltage Lockout Threshold	V_{IN} Rising		2.85		V
		V_{IN} Falling		2.60		V
R_{DIS}	Output Discharge Resistance	V_{IN}=5V,$\overline{CE}$=5V		400		Ω
I_{OCP}	OCP Current	Current Rising	100		2000	mA
	OCP Accuracy	V_{IN}=5V, T_A=25°C	-10		10	%
T_{SD}(1)	Thermal Shutdown	V_{IN}=5V		150		ºC
T_{SD_HYS}(1)	Thermal-Shutdown Hysteresis	V_{IN}=5V		20		ºC
Dynamic Characteristics						
t_{DEB}	Debounce Time	Time from V_{IN}<V_{OVLO} to V_{OUT}=10% of V_{IN}	10	20	30	ms
t_{ON}	Switch Turn-On Time	V_{IN}=5V, R_L=100Ω, V_{OUT} from 0.1×V_{IN} to 0.9×V_{IN}		40		us
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

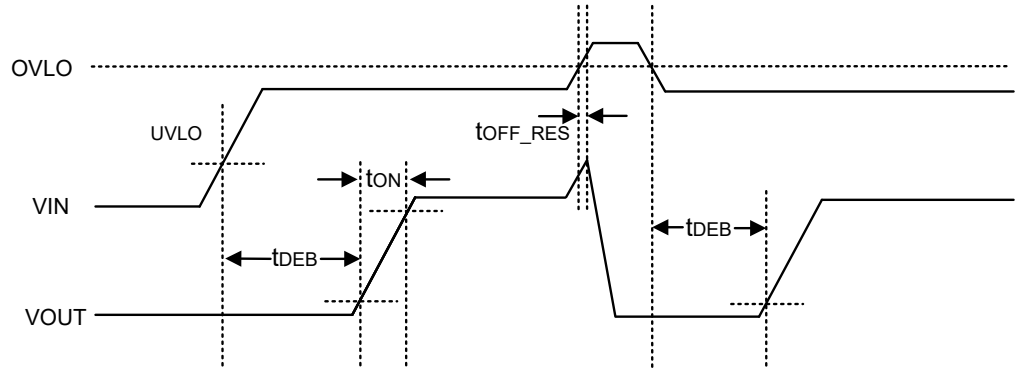


Figure 1. Timing for VIN Power ON and OVP

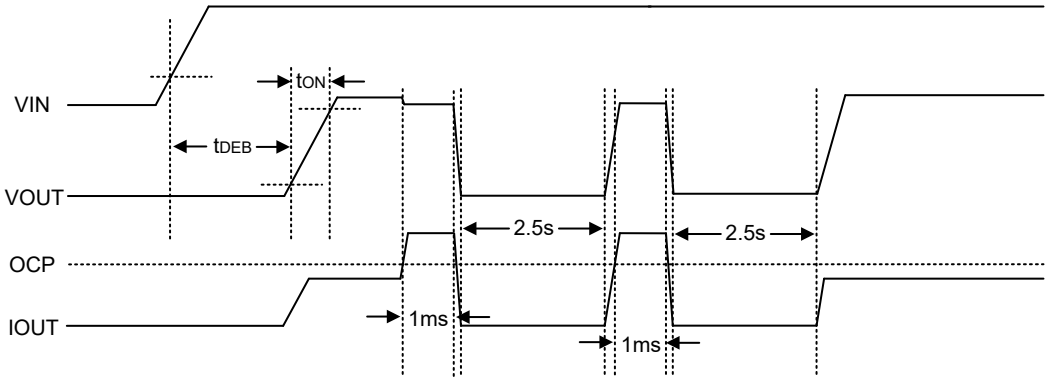


Figure 2. Timing for VIN Power ON and OCP

Application Circuits

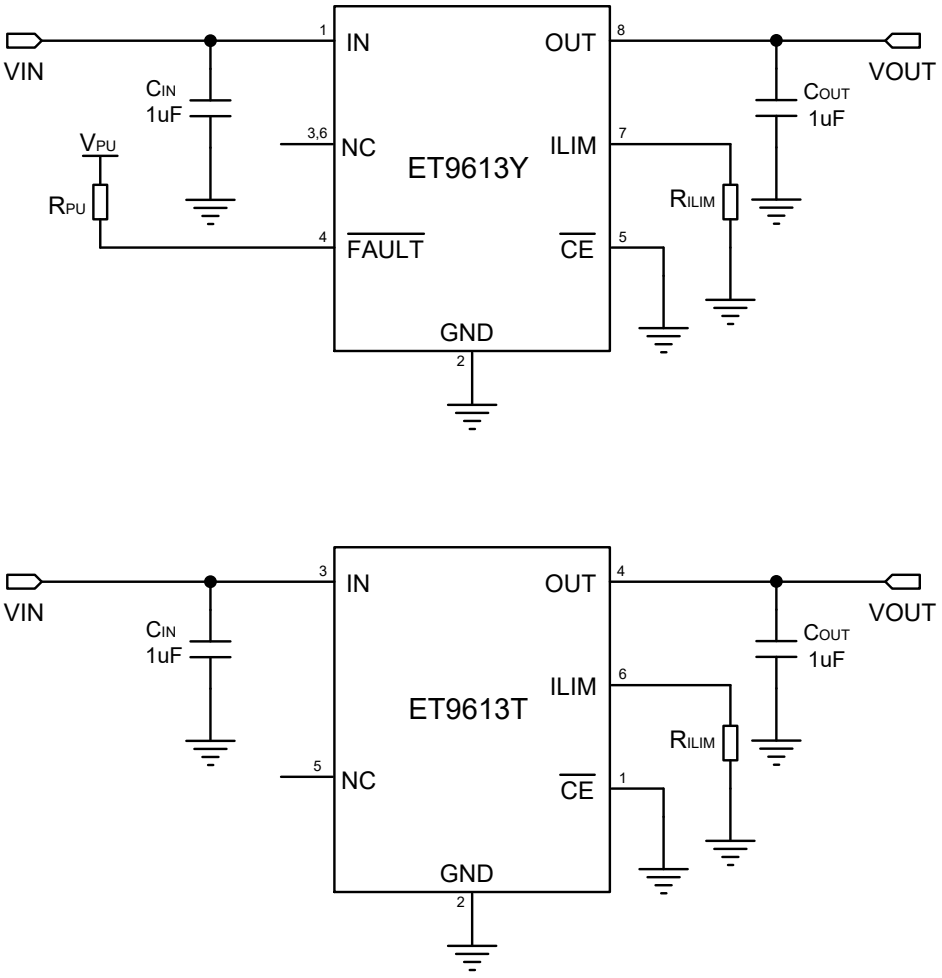


Figure 3. Typical Application Circuit

***Note*:** This electric circuit only supplies for reference. C_{IN}=1μF, C_{OUT}=1μF for reference.

Typical Characteristics

Unless otherwise noted, typical values are at V_{IN}=5V,C_{IN}=C_{OUT}=1μF and T_A=25°C.

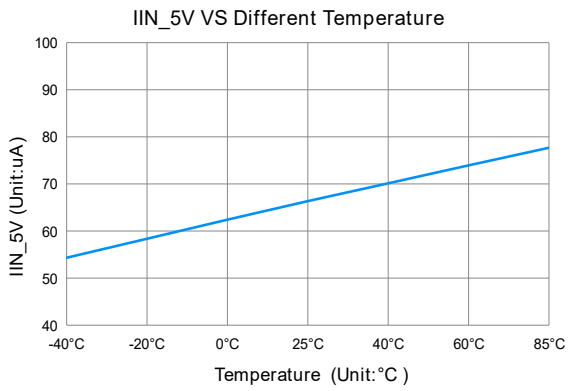


Figure 4. I_{IN_5V} Quiescent Current vs. Temperature

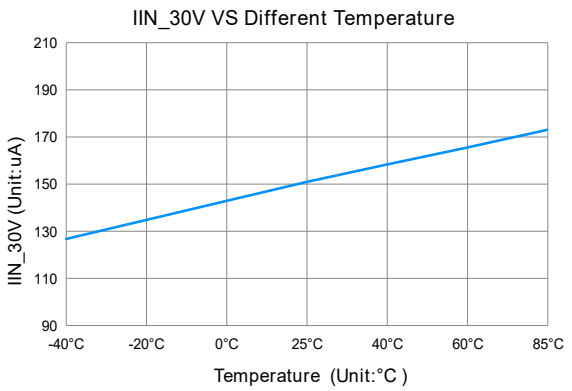


Figure 5. I_{IN_30V} Quiescent Current vs. Temperature

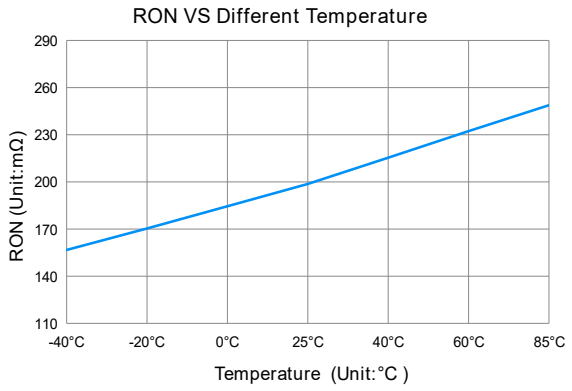


Figure 6. On-Resistance vs. Temperature

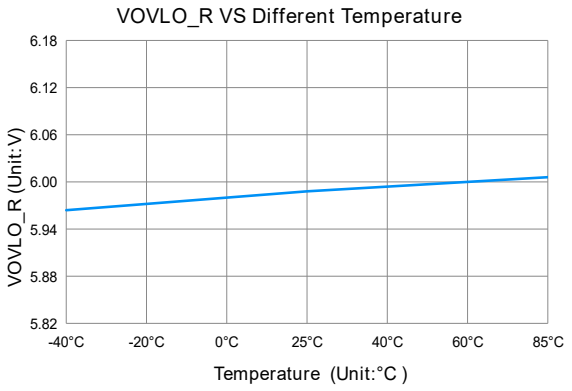


Figure 7. Over-Voltage Protect vs. Temperature

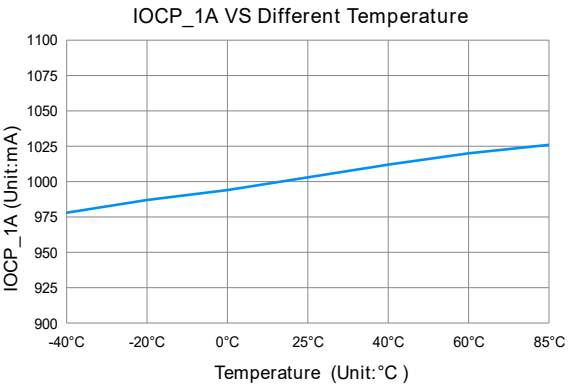


Figure 8. I_{OCP_1A} Current Limit vs. Temperature

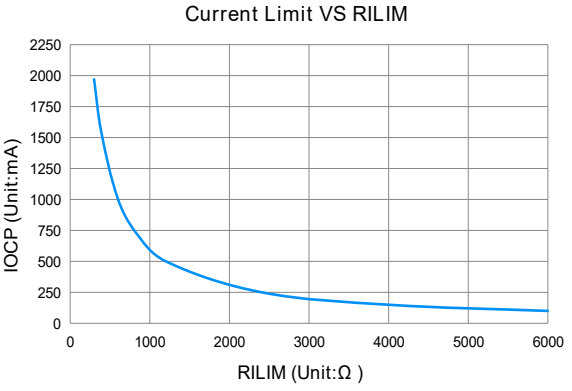
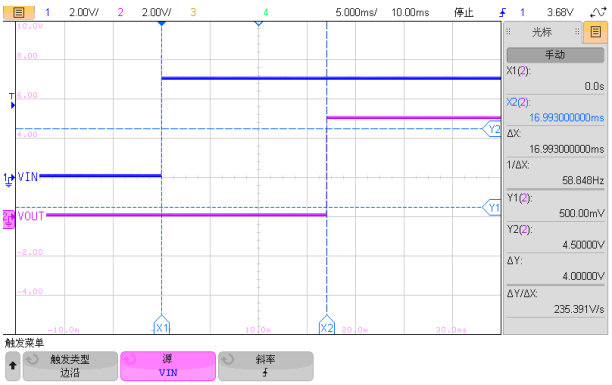


Figure 9. Current Limit Curve vs. R_{ILIM}

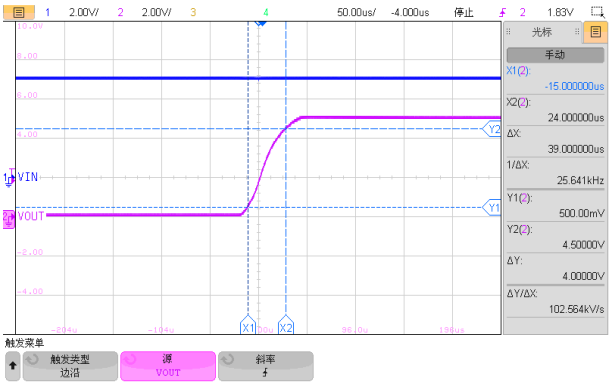
Typical Characteristics (Continued)

Unless otherwise noted, typical values are at V_{IN}=5V,C_{IN}=C_{OUT}=1μF and T_A=25°C.



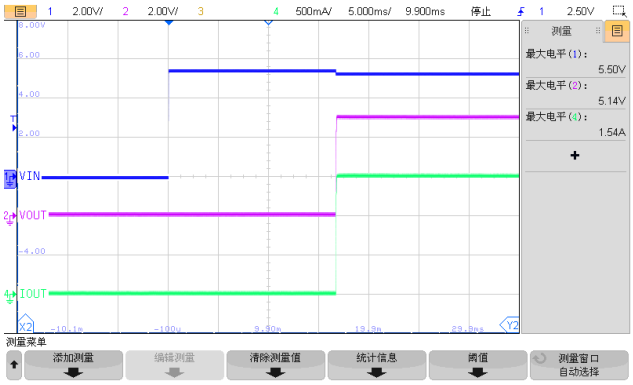
V_{IN}=0V to 5V, R_{LOAD}=100Ω

Figure 10. Switch Turn-On Delay Time



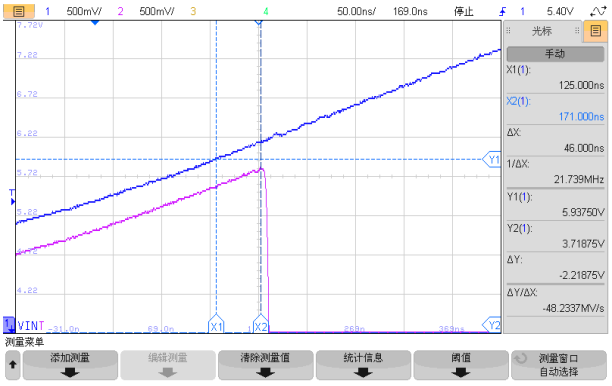
V_{IN}=0V to 5V, R_{LOAD}=100Ω

Figure 11. Switch Turn-On Time



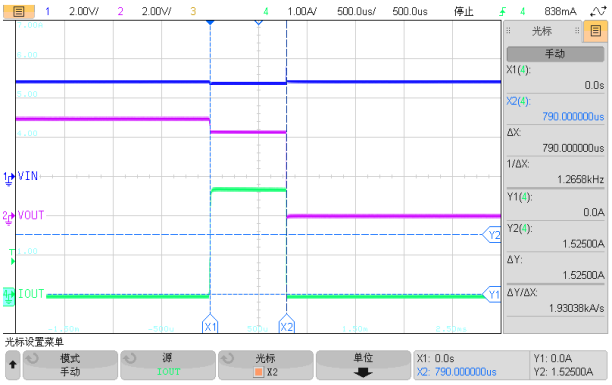
V_{IN}=0V to 5.5V, I_{OUT}=1.5A,

Figure 12. V_{IN} Power on Load Start



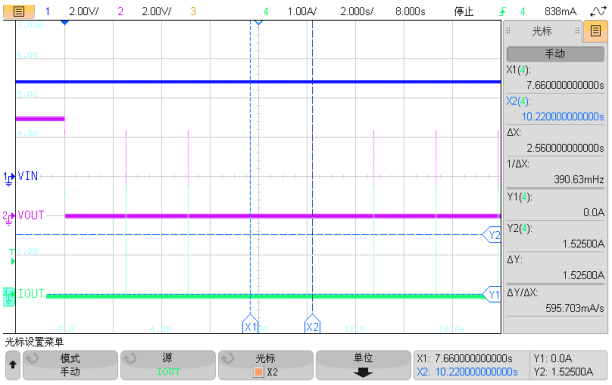
V_{OUT}=5.0V to 7.0V, C_{OUT}=0μF, R_{Load}=100Ω

Figure 13. Output OVP Response Time



V_{IN}=5V, R_{ILIM}=390Ω,

Figure 14. Over-Current Protection Turn-off Time

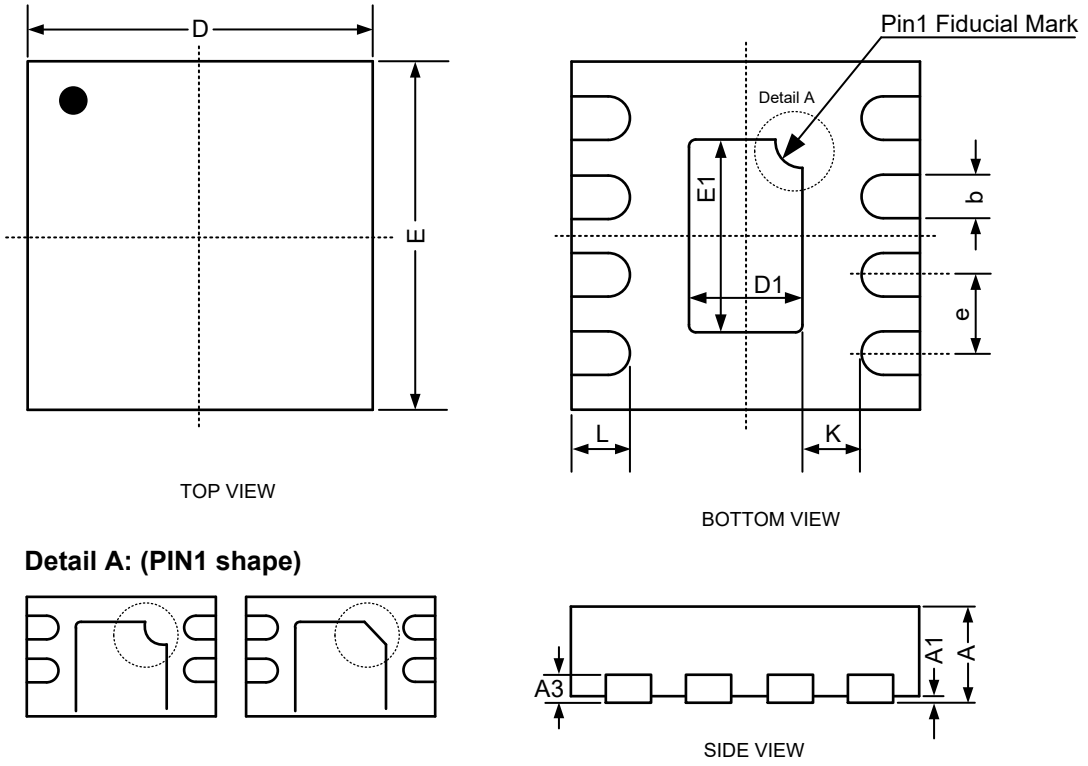


V_{IN}=5V, R_{ILIM}=390Ω,

Figure 15. Over-Current Protection Recovery Time

Package Dimension

DFN8(2.0mm × 2.0mm)



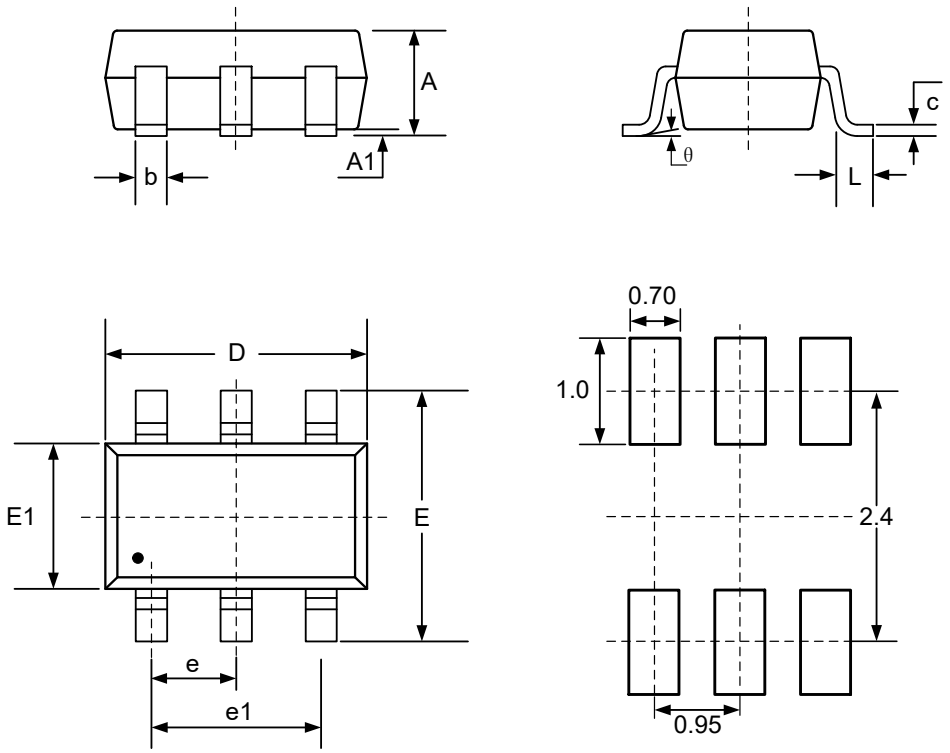
COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3		0.203REF	
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D1	0.50	-	1.00
E1	1.10	-	1.45
b	0.18	0.25	0.30
L	0.25	-	0.425
e		0.50BSC	
K	0.075	-	-

Package Dimension

SOT23-6

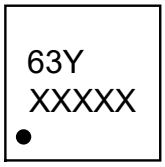


COMMON DIMENSIONS

(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	1.05	1.10	1.15
A1	0.00	0.05	0.10
b	0.30	0.40	0.50
c	0.10	0.15	0.20
D	2.82	2.92	3.02
E	2.65	2.80	2.95
E1	1.50	1.60	1.70
e	0.95BSC		
e1	1.90BSC		
L	0.30	0.45	0.60
θ	0°	4°	8°

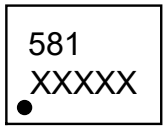
Marking



63Y = Part No.

XXXXX = Tracking No.

ET9613Y(DFN8)



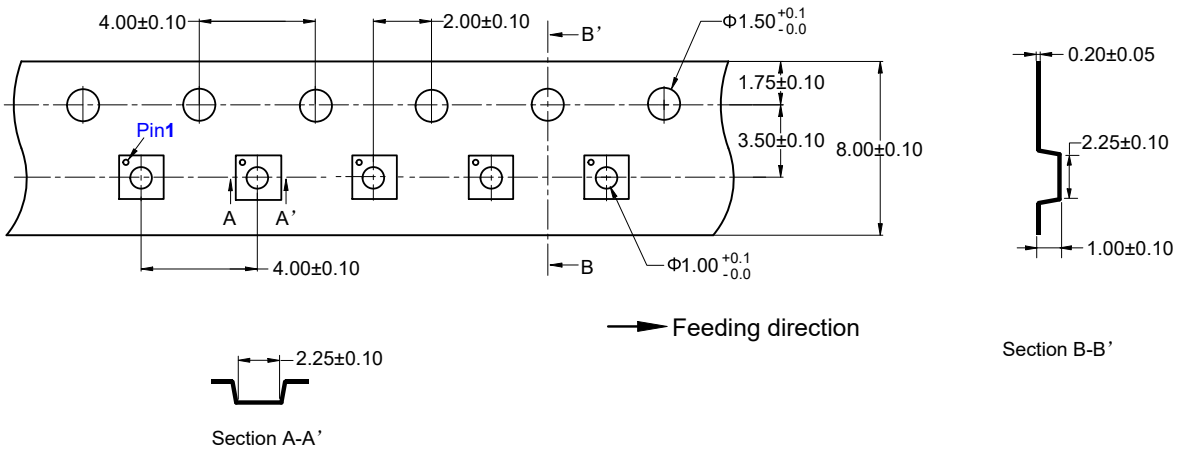
581 = Part No.

XXXXX = Tracking No.

ET9613T(SOT23-6)

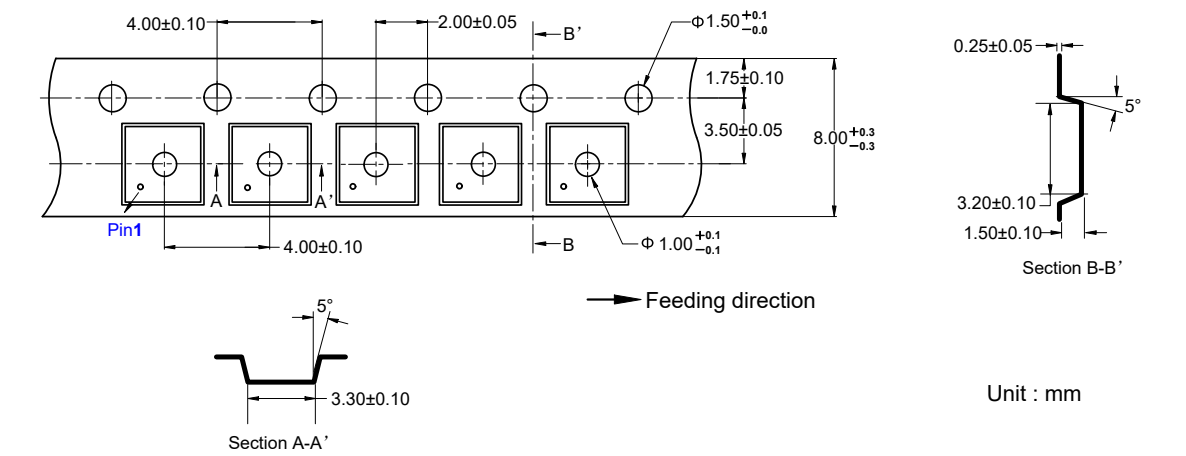
Tape Information

ET9613Y(DFN8)



Unit:mm

ET9613T(SOT23-6)



Unit : mm

Unit:mm

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2026-09-14	Initial version	Caojc	Liuks	Liujy