

1 Description

The CN1501 is a power management unit that integrates a load switch and a low noise, low dropout linear regulator for 12V input power supplies. The load switch is capable of supporting up to 1A output current, while the LDO provides 160mA output current with adjustable output voltage. The CN1501 ensures reliability with independent output short-circuit protection for each channel, thermal protection and input under-voltage lockout function, and input over-voltage protection.

The CN1501 is available in SOT23-6 and SOP8 packages. A compact solution is available with minimal external components.

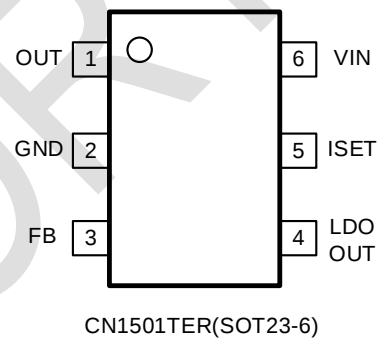
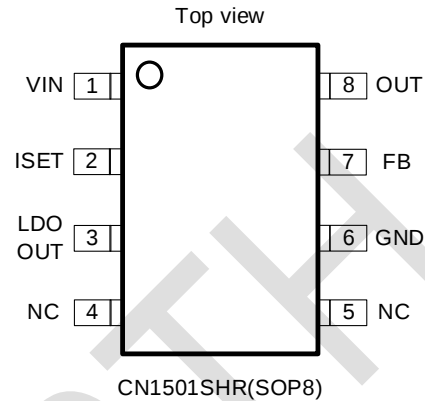
2 Features

- Low power consumption: quiescent current: 125uA
- Wide input voltage range: 5-18V
- Channel I : Adjustable Current Limit Load Switch
- Channel II : 160mA current limited LDO with adjustable output voltage
- Channel II output voltage accuracy of 2%
- Input overvoltage protection: 22.5V
- Overcurrent protection for dual channel independent hiccup mode
- Short circuit protection for dual channel independent hiccup mode
- Thermal shutdown
- Supports SOP8 and SOT23-6 packages.

3 Applications

- Smart Meters
- 12V Power Interface
- Portable Battery Powered Devices
- IP camera

4 Pinout



5 Ordering information

Product Number	Package	Marking	Quantity/Tape
CN1501SHR-A	SOP8	1501A YYWW	4000/Tape
CN1501SHRXX		1501XX YYWW	
CN1501TER-A	SOT23-6	1501A YYWW	3000/Tape
CN1501TERXX		1501XX YYWW	

Note: XX refers to the output voltage of LDO channel.

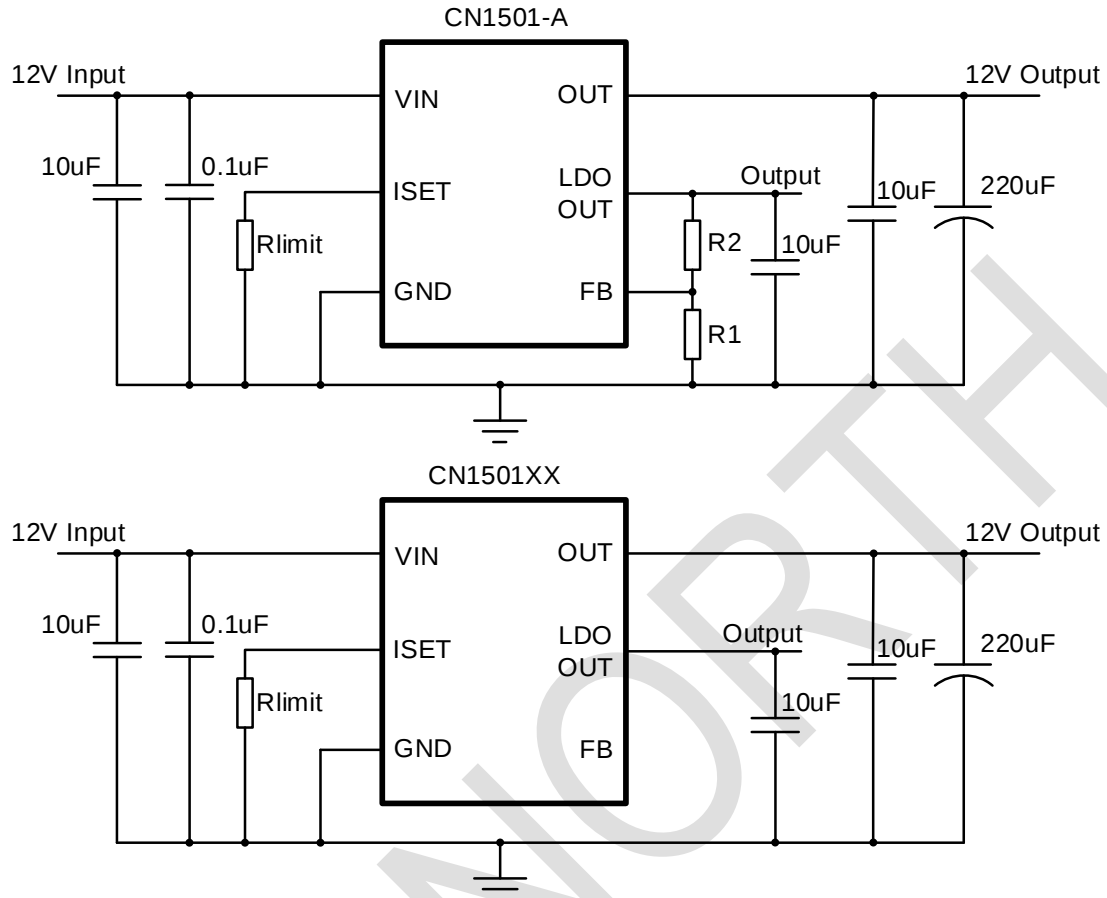
XX=50, means LDOOUT is 5V.

YY=Year WW=Week.

Green (RoHS & HF): CHIPNORTH defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your CHIPNORTH representative directly.

Moisture sensitivity level(MSL):3

6 Typical Application

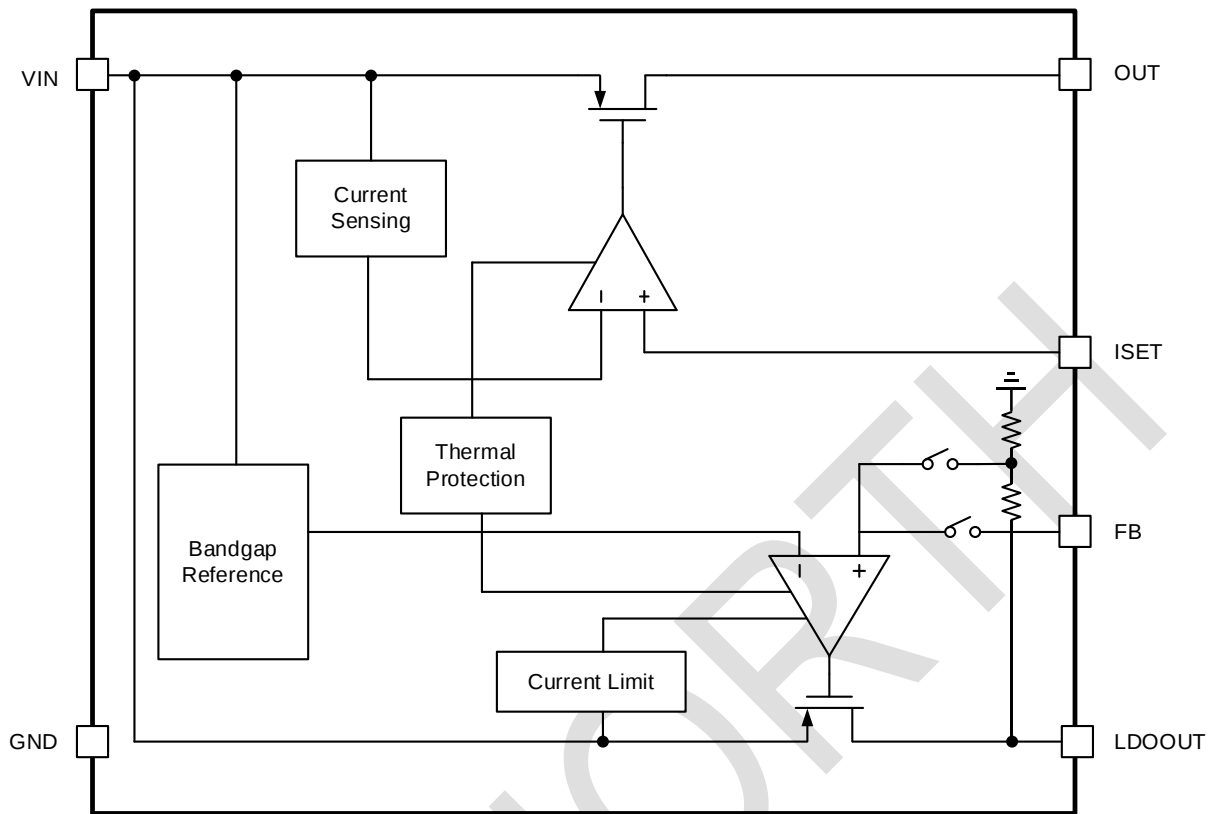


Note: CN1501XX: XX refers to LDO output voltage, e.g. CN1501TER50 refers to LDO fixed output 5.0V.

7 Pin Descriptions

Pin No.		Pin Name	Descriptions
SOT23-6	SOP8		
1	8	OUT	Load switch output pin.
2	6	GND	Ground.
3	7	FB	CN1501-A: LDO output voltage feedback pin. FB detects the output voltage of the LDO, which is regulated to 1.1V by the control loop, and a resistor divider is connected at FB. CN1501XX: FB float or short to ground.
4	3	LDOOUT	LDO output pin.
5	2	ISET	Current Limit Setting Pin. The current limit of the load switch can be programmed by connecting a resistor between the ISET pin and the GND pin. The current limit is typically 480mA when ISET is short to ground or floated.
6	1	VIN	Input pin.
	4	NC	No connect.
	5	NC	No connect.

8 Block Diagram



9 Specifications

9.1 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Input voltage	V_{IN}	-0.3~24	V
Output voltage Range	V_{OUT}	-0.3~24	V
ISET voltage	V_{ISET}	-0.3~6	V
FB voltage	V_{FB}	-0.3~6	V
LDO Output Voltage	V_{LDOOUT}	-0.3~12	V
Storage temperature	T_{stg}	-55~+150	°C

(1) Stresses exceeding the values listed under Absolute Maximum Ratings may cause permanent damage to the device. These listed values are stress ratings only and do not imply that the device will operate properly under these conditions or any other conditions other than the recommended operating conditions. Prolonged operation at maximum absolute rating conditions can affect device reliability.

(2) All voltage values are based on the ground terminal.

9.2 ESD Ratings

Discharge mode	Standard	Value	Units
HBM	ANSI/ESDA/JEDEC JS-001-2024	±3000	V
CDM	ANSI/ESDA/JEDEC JS-002-2022	±2000	V
Latch up	JESD78F.02-2023	±200	mA

9.3 Recommended Operating Range

Parameter	Symbol	Min.	Max.	Units
Input voltage range	V_{IN}	5	18	V
LDO Output Voltage Range	VLDOOUT	1.8	7	V
Operating Temperature	T_A	-40	85	°C

9.4 Thermal Information

Parameter	Package	Value	Unit
Junction to ambient thermal resistance(θ_{JA})	SOT23-6	220	°C/W
Junction to ambient thermal resistance(θ_{JA})	SOP8	100	°C/W

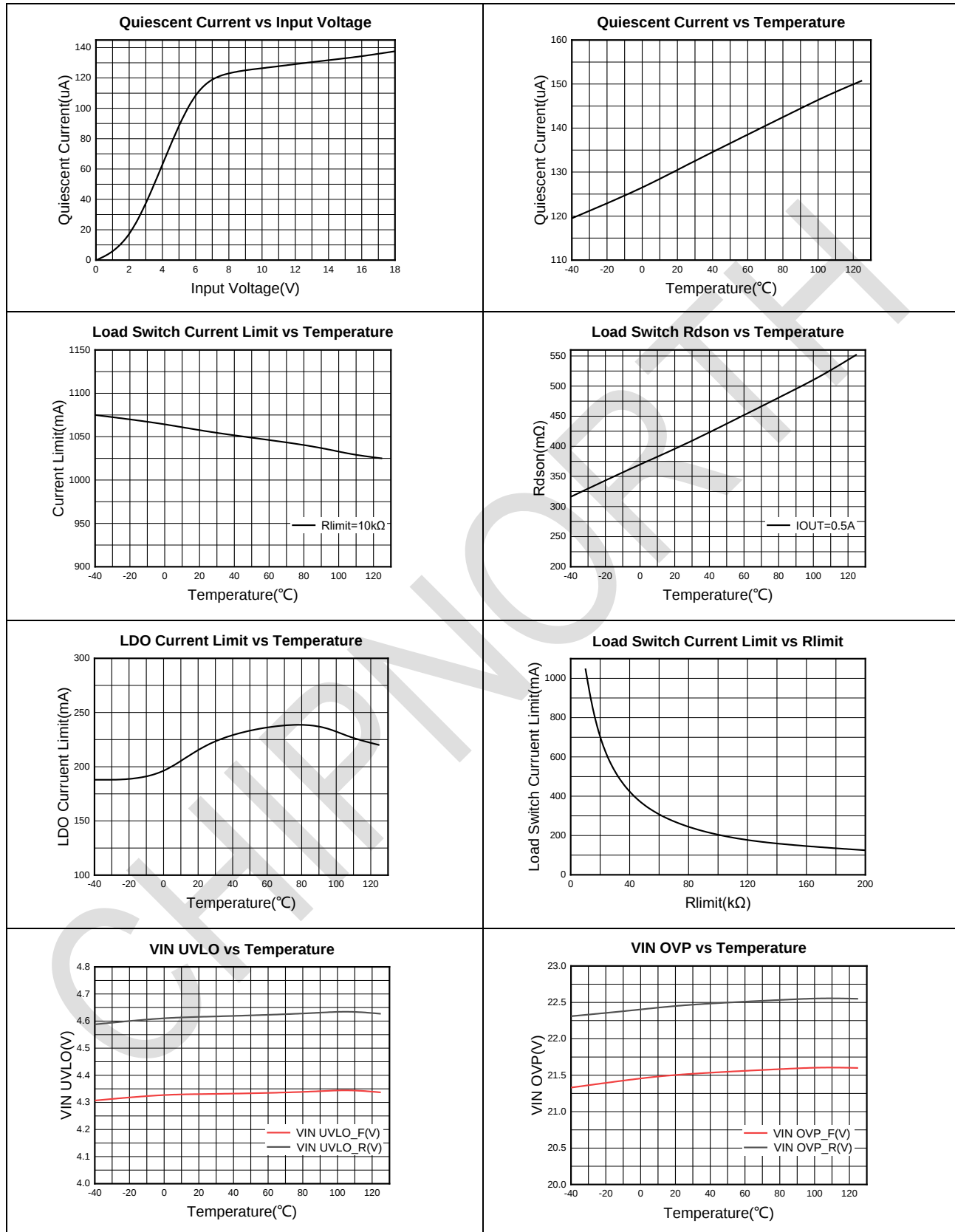
9.5 Electrical Characteristics

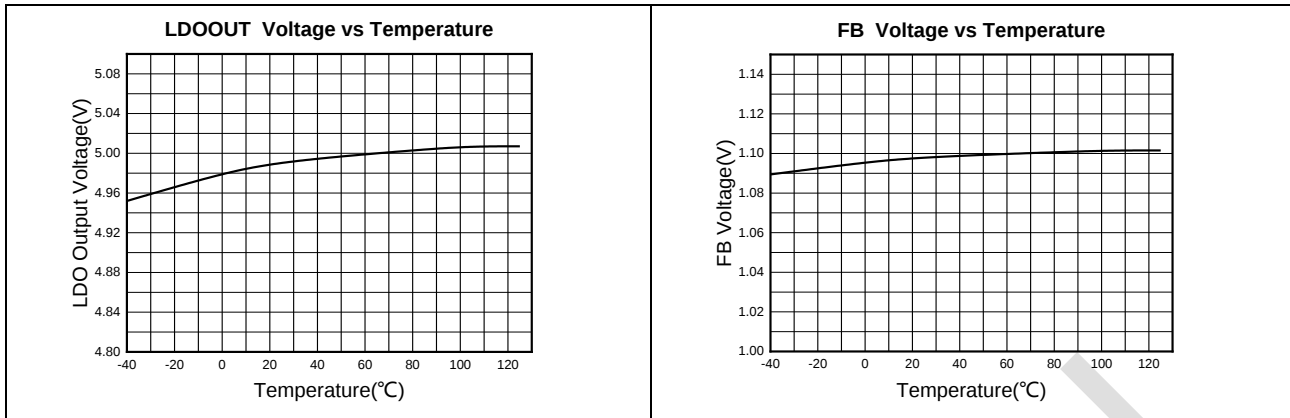
Test conditions: $V_{IN}=12V$, $T_A=25^{\circ}C$, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Voltage Range	V_{IN}		5		18	V
Quiescent Current	I_Q		60	125	190	μA
Input UVLO Threshold	V_{IN_UVLO}	VIN rising	4.4	4.6	4.8	V
Input UVLO hysteresis	$V_{IN_UVLO_HYST}$	VIN falling		0.3		V
Input OVP Threshold	V_{IN_OVLO}	VIN rising		22.5		V
Input OVP hysteresis	$V_{IN_OVLO_HYST}$	VIN falling		1		V
Load Switch On-resistance	$R_{DS(on)}$	IOUT=1A, OCP threshold setting greater than 1.2A	200	400	600	m Ω
Load Switch Current Limit	I_{LIM_OUT}	Rlimit=200K Ω		0.1		A
		Rlimit=10K Ω	0.95	1.05	1.15	A
		Float ISET pin	0.42	0.48	0.54	A
Load Switch Short Circuit Current Limit		OUT short to GND		0.09		A
LDO Output Voltage Accuracy		Internal integrated voltage divider resistor	-2		2	%
FB Voltage Accuracy		CN1501-A	1.1*0.9 8	1.1	1.1*1.0 2	V
LDO Dropout Voltage	V_{DROP}	I _{LDOOUT} =100mA@V _{OUT} =5V		100		mV
LDO Current Limit	I_{LIMIT_LDO}		160	220		mA
OUT Short Circuit Detection Time	T_{dect_OUT}			211		ms
OUT short-circuit hiccup interval	T_{hicup_OUT}			3.24		s
LDOOUT short-circuit detection time	T_{dect_LDOOUT}			53		ms
LDOOUT short-circuit hiccup interval time	T_{hicup_LDOOUT}			0.81		s
Over-temperature protection point	T_{TSD_OUT}			160		$^{\circ}C$
Over-temperature protection hysteresis	T_{TSD_HYST}			30		$^{\circ}C$

9.6 Characteristics Curve (CN1501TER50)

Test conditions: $V_{IN}=12V$, $T_A=25^{\circ}C$, unless otherwise specified.





10 Detailed Description

10.1 Overview

The CN1501 is a PMU that integrates a load switch and a low noise LDO, with the Channel I load switch providing up to 1A output current and the Channel II LDO regulator providing up to 160mA output current. The CN1501 is available in LDO fixed output version CN1501XX and LDO adjustable output version CN1501-A.

10.2 Current Limit Protection

The CN1501 contains two independent current limit circuits for monitoring and controlling the gate voltage of the pass transistors to limit the output current to a certain value. The current limit of the LDO is fixed at 220mA, and the current limit of the load switch can be set by the external resistor R_{limit} on the ISET pin.

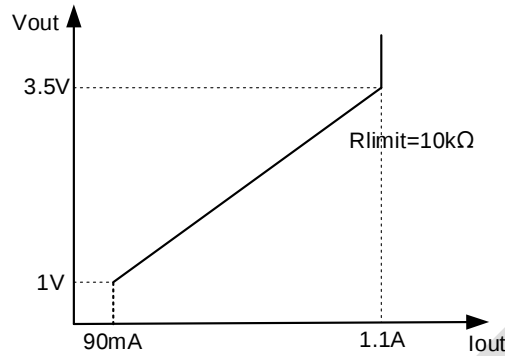
Once the load switch output current reaches the current limit threshold, the internal circuit regulates the gate voltage to maintain a constant power MOSFET current. In order to limit the current, the gate-to-source voltage must be regulated from 5V to about 1V. Typical response time is about 15 μ s, during which a small overshoot of the output current may occur. The CN1501 allows the ILIMIT pin to be floated or shorted to ground during operation. If the ILIMIT pin is floated or shorted to ground, the current limit is internally set to 480mA.

10.3 Short Circuit Protection

The CN1501 incorporates an independent short-circuit protection function. If the load current increases rapidly due to a short circuit, the current may exceed the current limit threshold before the control loop reacts. when the current exceeds 1.5 times of the current limit value, the short circuit protection function will be triggered and the fast shutdown circuit will be activated to shut down the power MOSFET. when the chip triggers the short circuit protection, it will be restarted once for checking whether the short circuit exists. If the short circuit still exists when the device is restarted, the CN1501 will adjust the gate voltage to keep the current at the short-circuit current limit level. If the short-circuit condition at the OUT pin remains for more than 210 ms, the IC enters hiccup mode and the power FETs are forced off and enabled again after 3.2 s. If a short-circuit condition at the LDOOUT pin is maintained for more than 50 ms, the IC enters hiccup mode and the power FET is forced off and re-enabled after 0.8s.

10.4 Load Switch Fold Back Function

The CN1501's load switch current limit protection integrates a fold back protection function. When the OUT voltage is less than 3.5V, the ILIMIT threshold decreases as the VOUT voltage decreases, with a downward slope of 400 mA/V, and the minimum current limit is the short-circuit current limit.



10.5 Input Overvoltage Protection

When the input voltage exceeds the protection threshold (typically 22.5V), the CN1502TER will be disabled. When the input voltage drops below 21.5V, the CN1502TER will be reactivated.

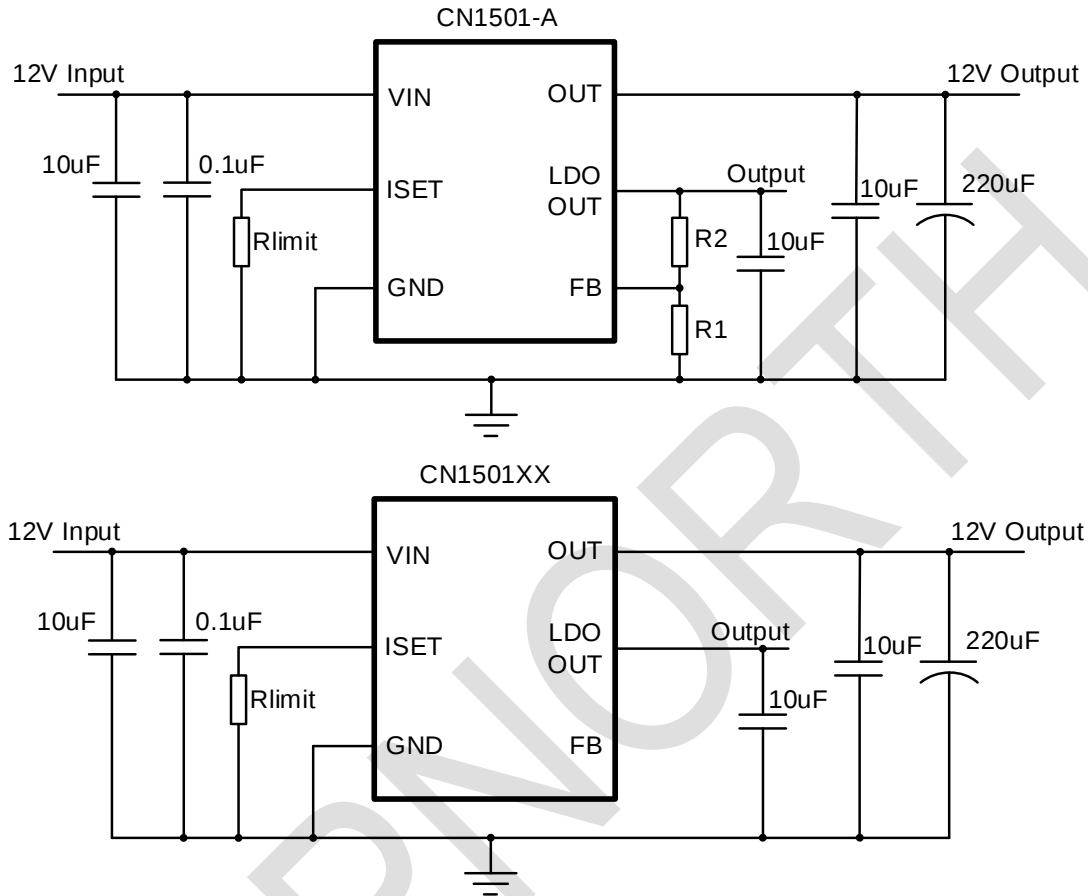
10.6 Thermal Shutdown

When the temperature of CN1502TER rises above 160°C, it will enter a thermal shutdown state. The device can only be reactivated when the temperature drops below 130°C.

11 Application information

11.1 Typical applications

The following figure shows a typical application schematic for a circuit that can be used to evaluate the performance of the CN1501.



11.2 LDO Output Voltage Setting

For CN1501-A version, its LDO channel output voltage can be set by external feedback resistor, and the output voltage is calculated as follows:

$$V_{OUT} = V_{FB} \times \left(1 + \frac{R_2}{R_1}\right)$$

where VFB is typically 1.1V typical (internal reference voltage).

11.3 Load Switch Current Limit Setting

The current limit value of the load switch can be set by the external resistor Rlimit on the ISET pin. The formula for calculating ILIMIT is as follows:

$$I_{LIMIT} = \frac{10K}{R_{limit}} + 50mA$$

When the ISET pin is floating or shorted to ground, the current limit is set internally to 480mA.

11.4 Input Capacitor Selection

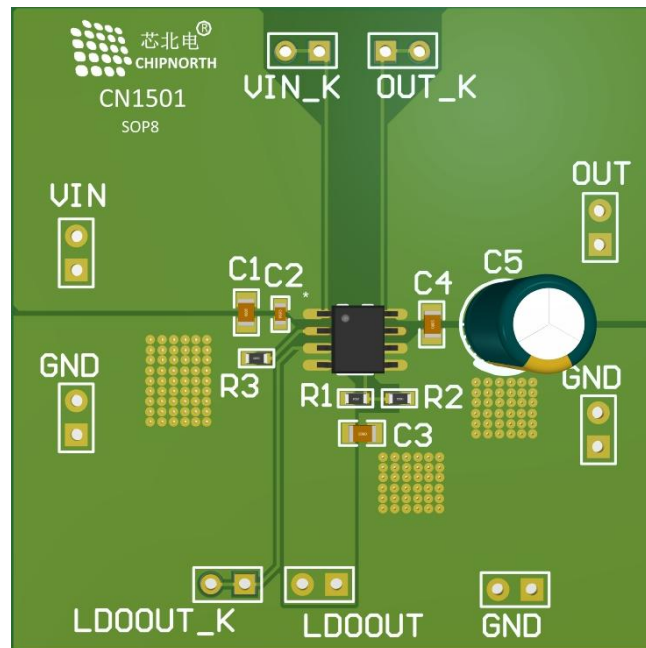
Too small input capacitance will weaken the buffer ability of the chip against transient high-current events, leading to deterioration of power integrity, abnormal voltage and protection failure, and then lead to electrical or thermal damage of the chip. Therefore, placing a reasonable capacitance near the input pin

of the chip can improve the system reliability. For example, in the application scenario with $V_{IN}=16V$, it is recommended to place a capacitor not less than $4.7\mu F/50V$ at the input.

11.5 PCB Layout

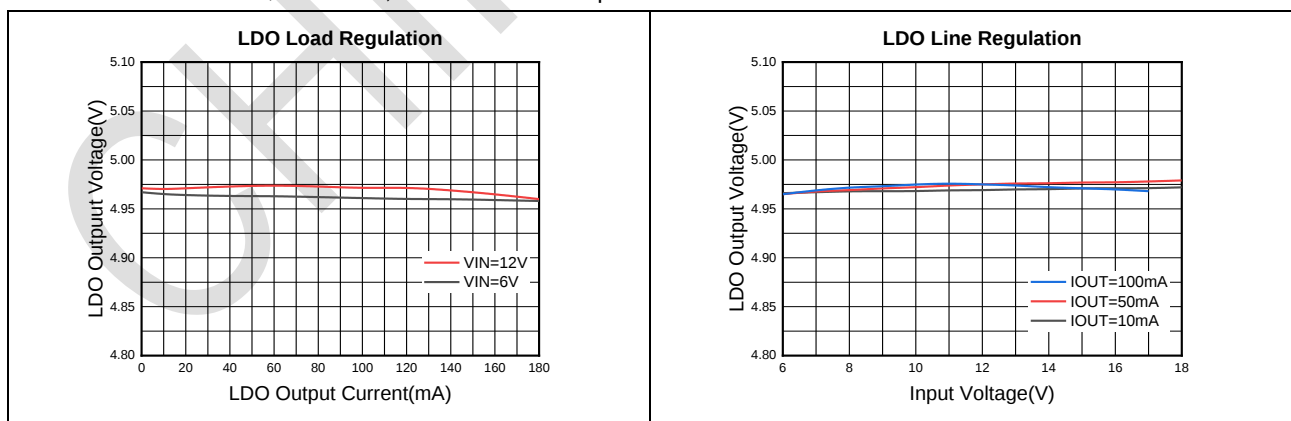
An efficient layout is essential for stable operation. For best results, refer to the diagram below and follow these guidelines

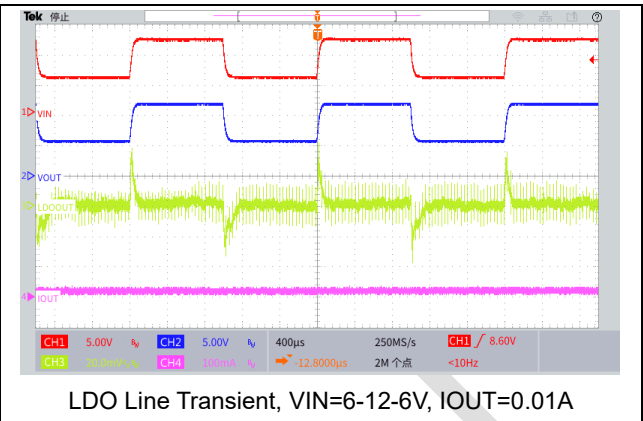
- Place the high current paths (V_{IN} and V_{OUT}) close to the device, using short, straight and wide leads.
- Place the input capacitors close to the V_{IN} and GND pins.
- Connect V_{IN} and V_{OUT} pads to large V_{IN} and V_{OUT} planes to improve thermal performance.
- Place a current limiting resistor externally near the ISET pin pads.



11.6 Basic Performance

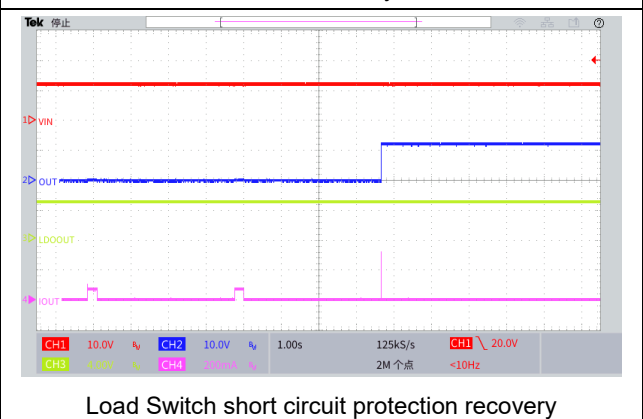
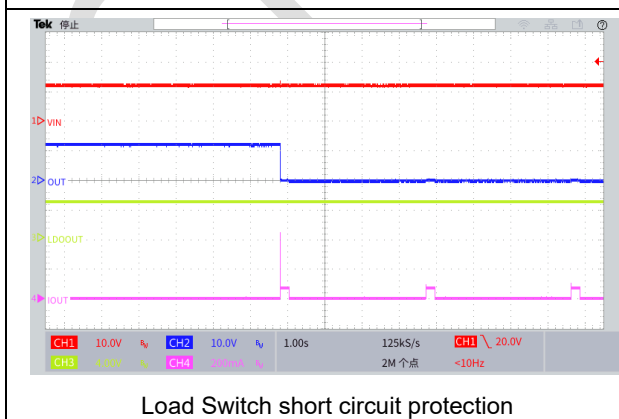
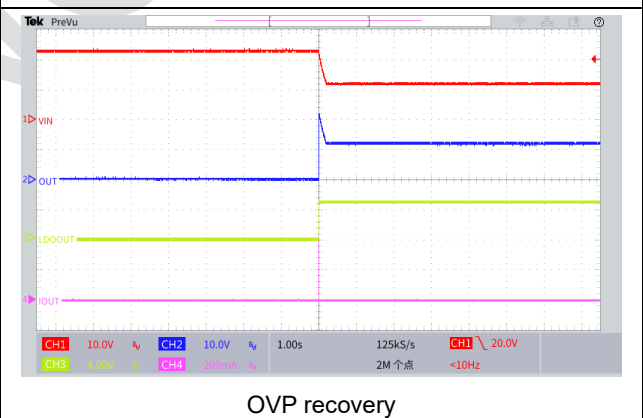
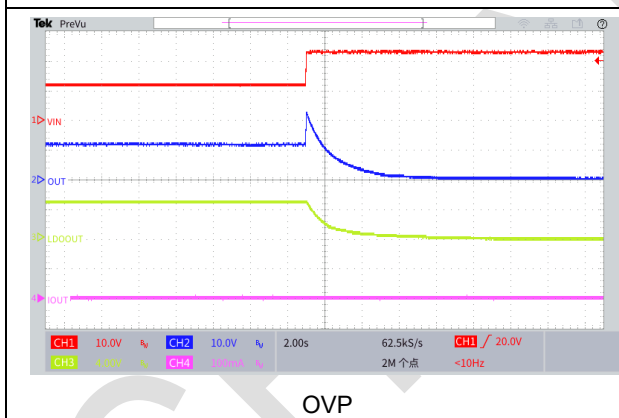
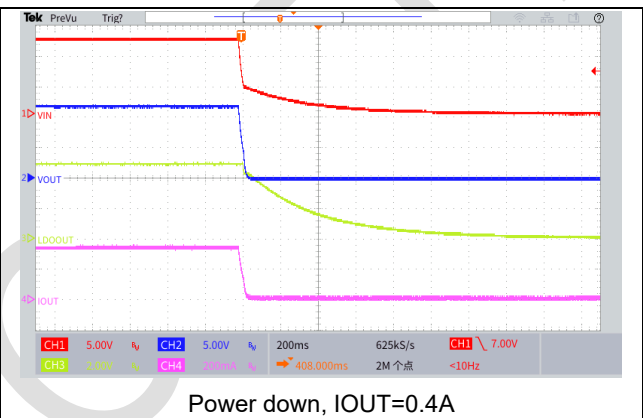
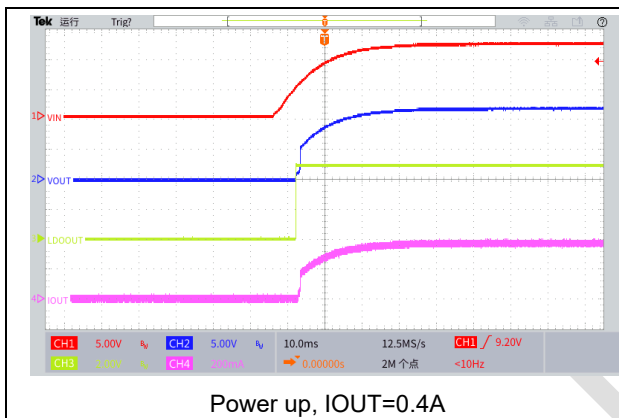
Test conditions: $V_{IN}=12V$, $T_A=25^\circ C$, unless otherwise specified.

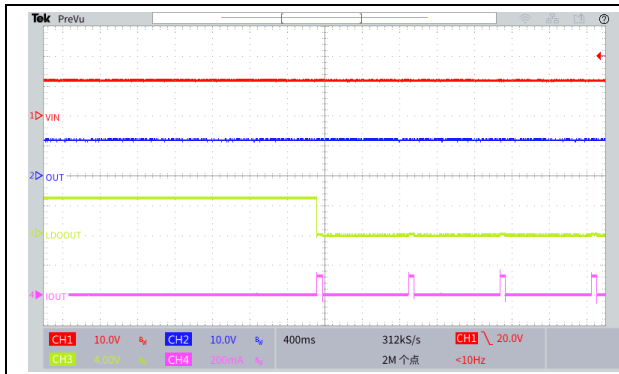




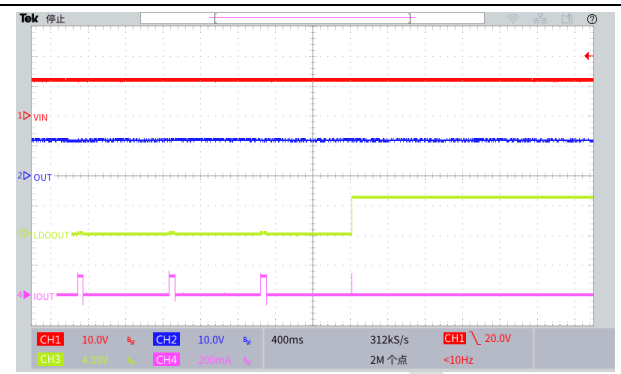
11.7 Operating waveforms

Test conditions: $V_{IN}=12V$, $T_A=25^{\circ}C$, unless otherwise specified.





LDO short circuit protection

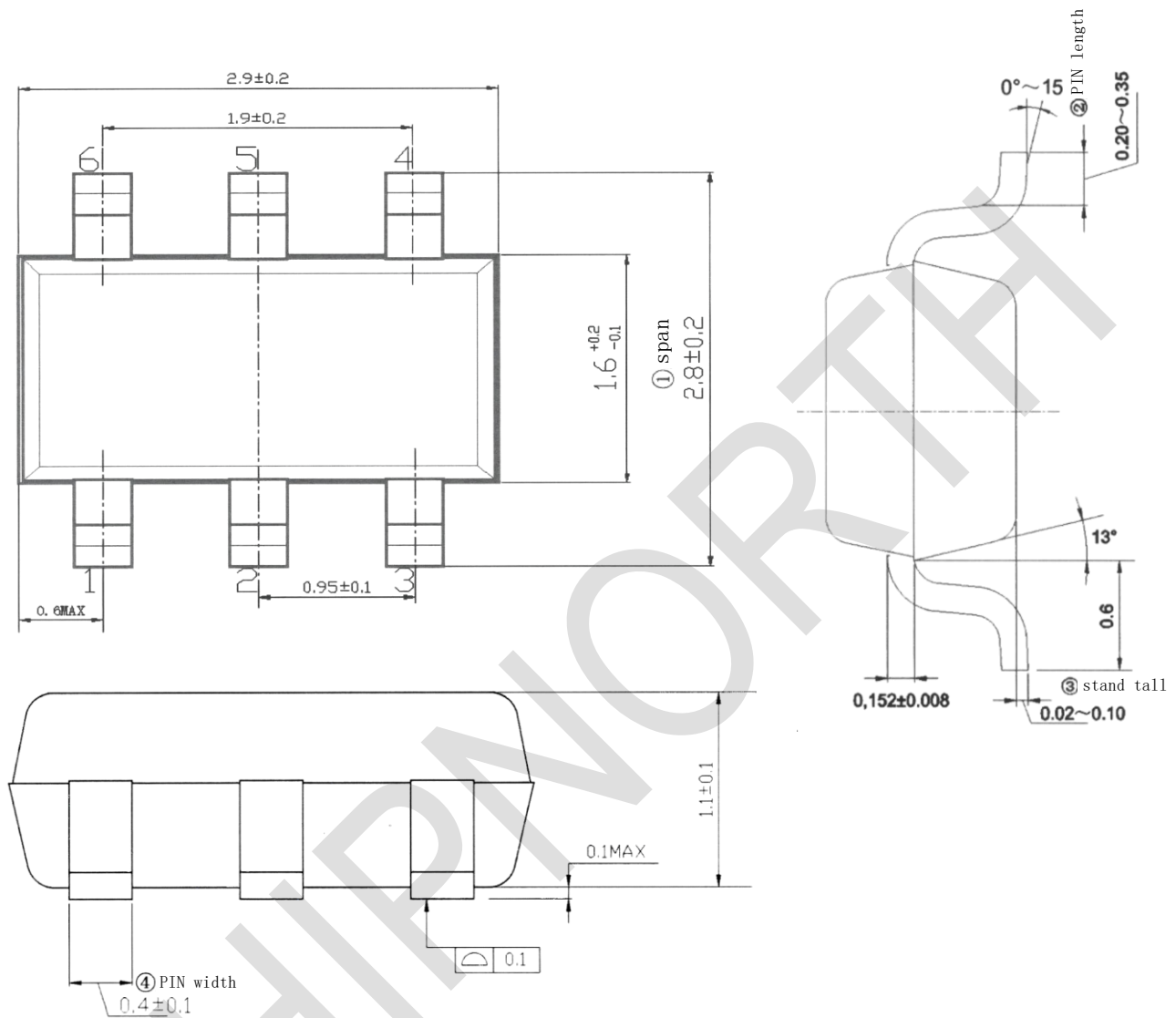


LDO short circuit protection recovery

12 Package Information

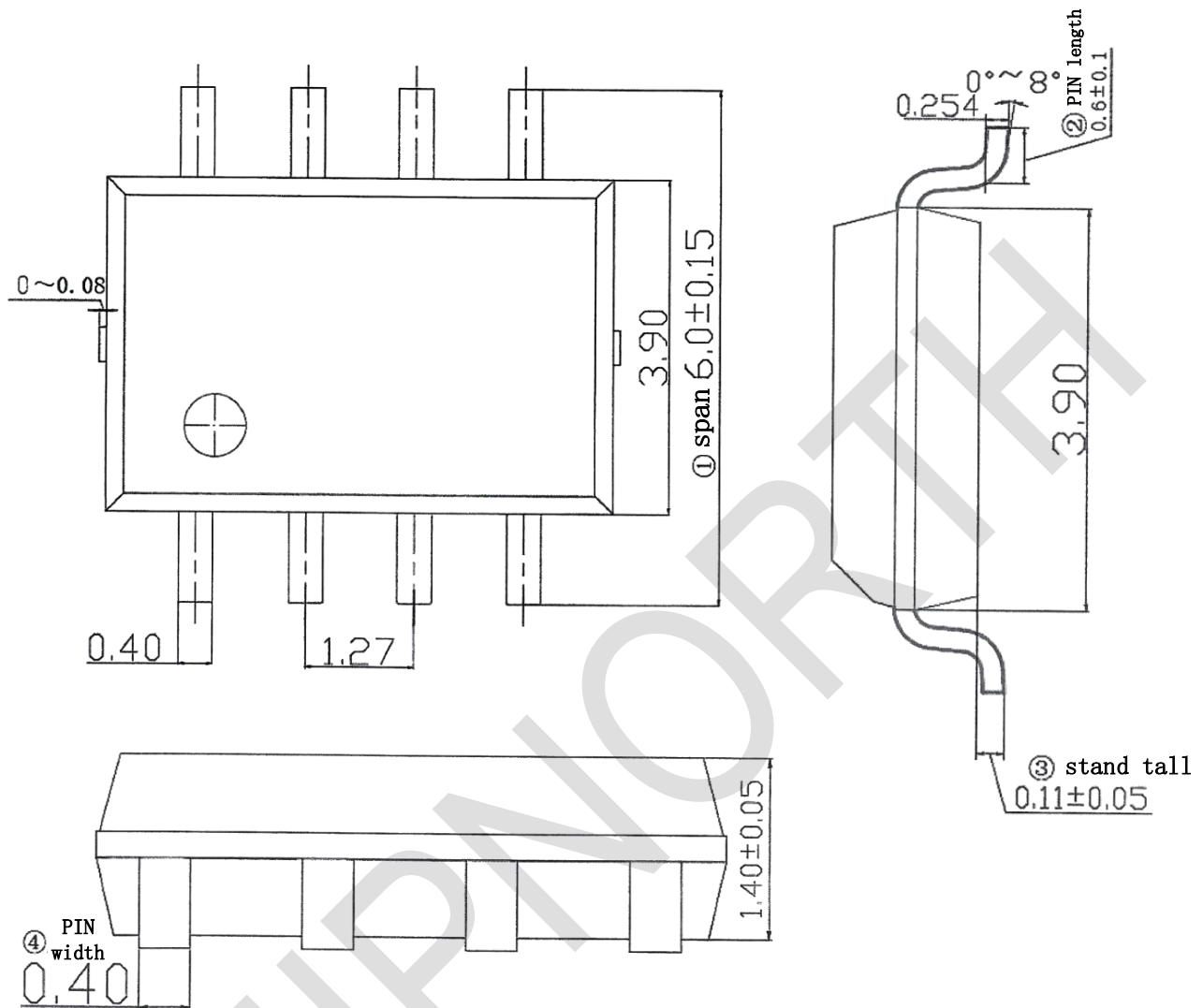
SOT23-6

unit: mm



SOP-8L

unit: mm



13 Important Statement

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