1 Description

The CN54123A/B/C/D is a precision, low-power, Ground Fault Circuit Interrupter (GFCI) controller used for detecting ground fault leakage paths in electrical circuits,witch can detect type AC leakage currents. When the leakage current occurs on the L and N lines, the ZCT(zero current transformer) will detect the leakage current signal,the post-circuit converts the leakage current signal into a voltage signal and transmits it to the input terminal of the chip, when the peak value of the input voltage signal exceeds 4.95mV, the output pin of the chip generates a high level with a minimum duration of 20ms to drive the external SCR.

The CN54123A/B/C/D integrates functional modules such as regulated power supply, amplification circuit, comparison circuit, trip controller and trip drive circuit, and only needs current transformer and a small number of resistor capacitors externally.

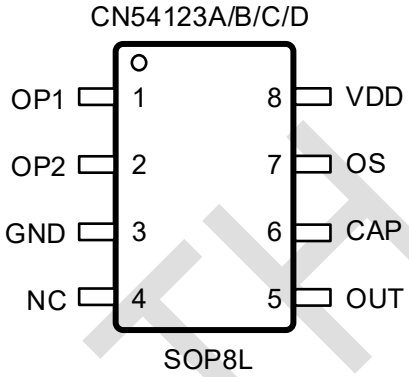
2 Features

- Applied in AC type leakage
- High input sensitivity (4.95mV typical)
- Low quiescent current of 190uA
- Wide operating voltage range (3V~5.5V)
- Wide AC input voltage range: 50V~380V(50/60Hz)
- >20ms output pulse width can drive SCR
- Consistent leakage detection threshold
- Delay time can be adjusted
- Excellent EMC protection
- Wide operating temperature range (Ta=-40~+105°C)

3 Applications

- Ground Fault Circuit breakers
- Ground Fault Circuit relays

4 Pin Configuration



5 Ordering Information

Part NO	Package	Qty/Tape
CN54123A	SOP8L	4000/Tape
CN54123B	SOP8L	4000/ Tape
CN54123C	SOP8L	4000/ Tape
CN54123D	SOP8L	4000/ Tape

6 Marking

Part NO	Marking
CN54123A	54123 YYWW
CN54123B	54123B YYWW
CN54123C	54123C YYWW
CN54123D	54123D YYWW

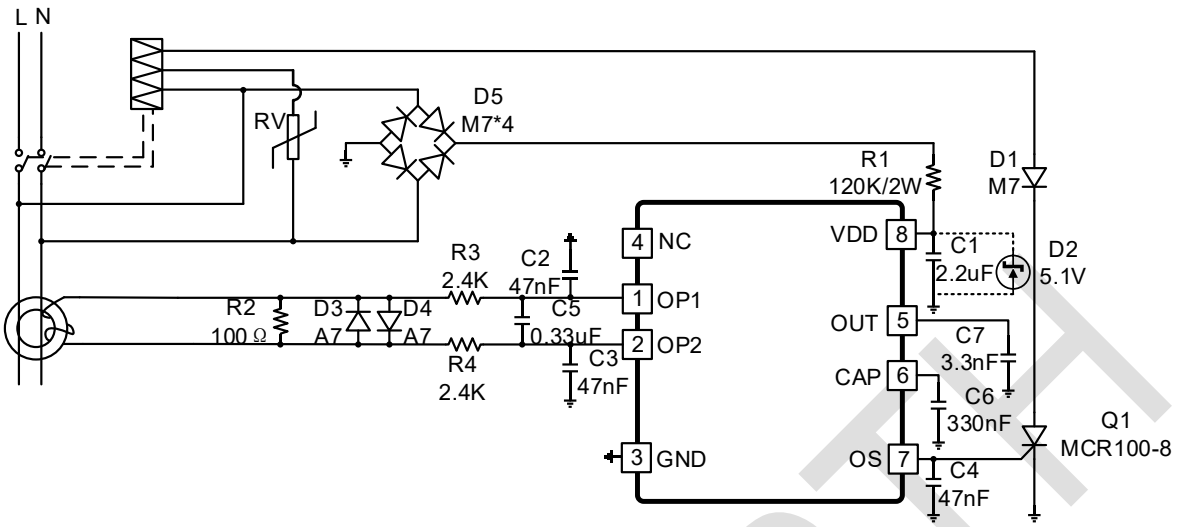
Note: YY=Year WW=Week.

Green (RoHS & HF): CHIPNORTH defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances.

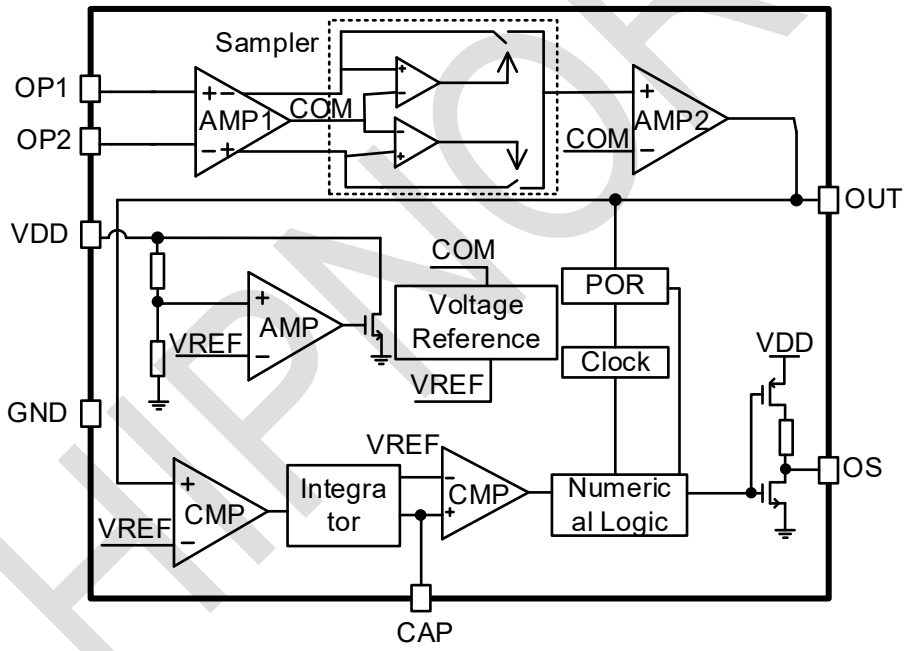
If you have additional comments or questions, please contact your CHIPNORTH representative directly.

Moisture sensitivity level(MSL):3

7 Typical Application



8 Block Diagram



9 Pin Descriptions

PIN NO	PIN Name	Description
1	OP1	Signal amplifier input 1
2	OP2	Signal amplifier input 2
3	GND	Ground
4	NC	No connect
5	OUT	Amplifier output, connect capacitor
6	CAP	Delay setting, connect capacitor
7	OS	Output control SCR
8	VDD	Power Supply Input

10 Specifications

10.1 Absolute Maximum Ratings

Parameter	Value	Units
Operation Voltage	-0.4~+8	V
Other Pins	GND - 0.3, VDD + 0.3	V
Soldering temperature	260（soldering,10s）	°C
Operating Ambient Temperature Range	-40~+105	°C
Storage Temperature Range	-55~+155	°C

Note*: Stress exceeds these ratings listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Expose to absolute-maximum-rated conditions for extended periods may affect device reliability.

10.2 ESD Ratings

Discharge mode	Specification	Value	Units
HBM	ESDA/JEDEC JS-001-2017	±8000	V
CDM	ANSI/ESDA/JEDEC JS-002-2022	±2000	V

10.3 Recommended Operating Range

Parameter	Symbol	Min.	Max.	Units
Operation Voltage	VDD	3	5.5	V
Operating Ambient Temperature Range	T_A	-40	105	℃

10.4 Thermal Information

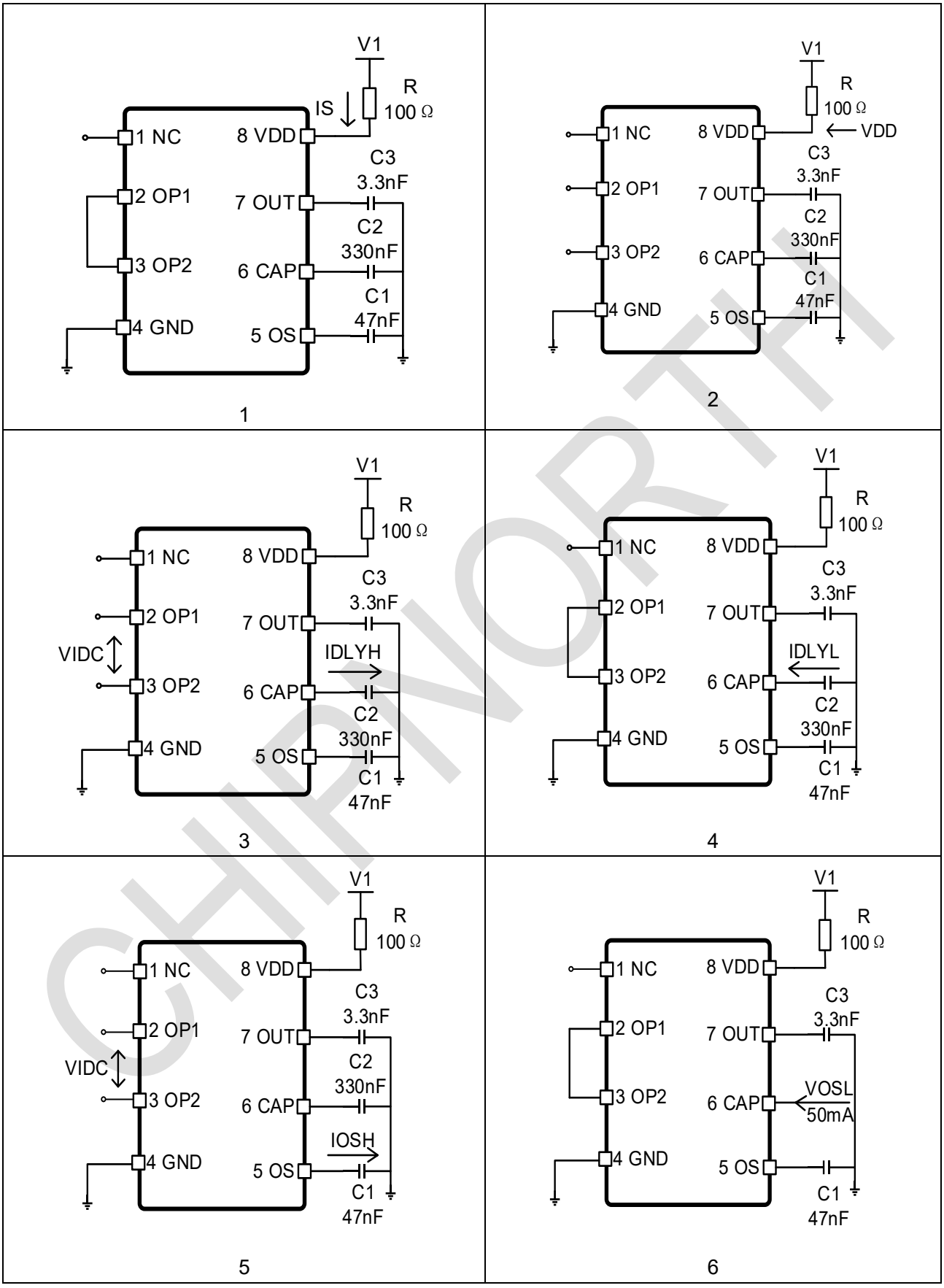
Parameter	Symbol	Value	Unit
Junction-to-ambient thermal resistance	$R\theta_{JA}$	100	°C/W

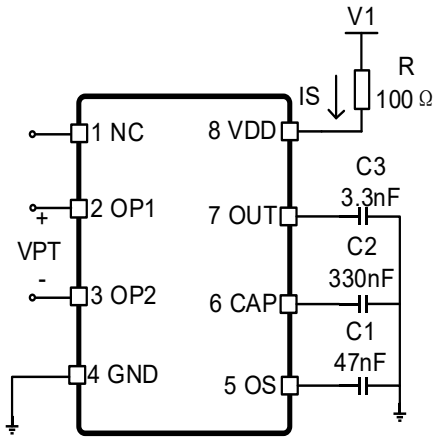
10.5 Electrical Characteristics

(V_{IN}=4.5V, T_A=25°C, unless otherwise specified.)

Parameter	Symbol	Conditions	Test circuit	Min	Typ	Max	Unit
Quiescent current	IQ	VCC=4.5V OP1 - OP2=0mV	1	100	190	280	uA
Operation Voltage	VDD	I_VCC=5mA	2	4.6	4.8	5	V
CAP outputs high current	I_CAPH	OP1 - OP2=30mV	3	50	65	80	uA
CAP outputs low current	I_CAPL	OP1 - OP2=0mV	4	1.5	2	2.5	uA
OS outputs high current	I_OSH	OP1 - OP2=30mV， CN54123A	5	1	1.7	3	mA
		OP1 - OP2=30mV， CN54123B		1	1.7	3	mA
		OP1 - OP2=30mV， CN54123C		0.18	0.23	0.28	mA
		OP1 - OP2=30mV， CN54123D		0.18	0.23	0.28	mA
OS outputs low voltage	V_OSL	OP1 - OP2=0mV, IOSL=10mA	6		0.05	0.112	V
Positive operating voltage	V_PT	OP1 - OP2	7	4.65	4.95	5.35	mV
Negative operating voltage	V_NT	OP2 - OP1	8	4.65	4.95	5.35	mV
Latch time	TON	CN54123A	9	20			mS
		CN54123B		20	32	45	mS
		CN54123C		20			mS
		CN54123D		20	32	45	mS

10.6 Test Circuit





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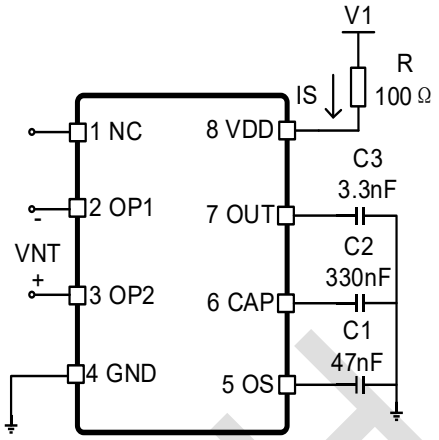

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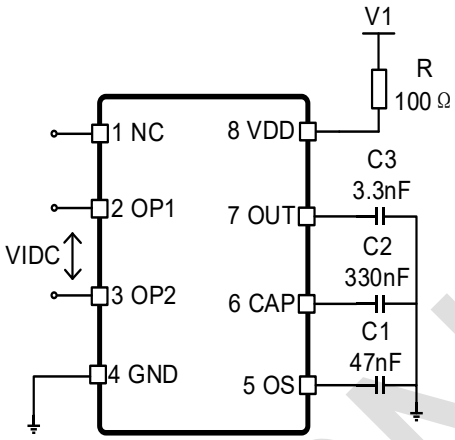

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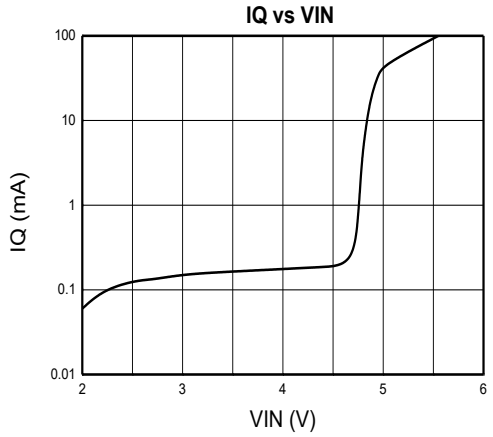
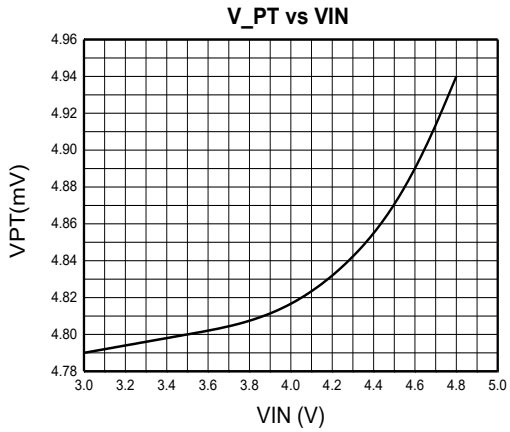
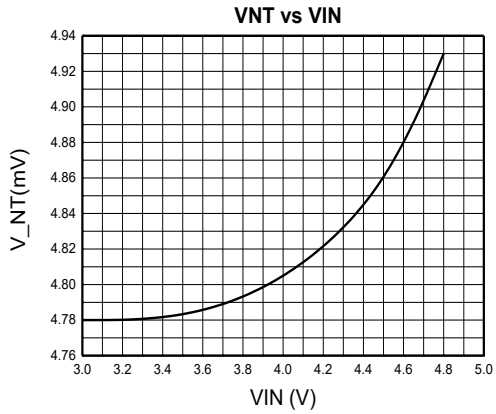
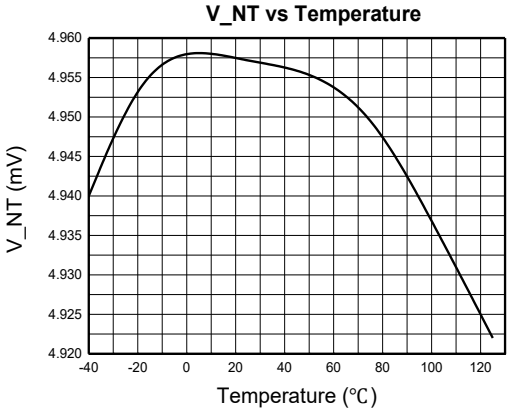
10.7 Characteristics Curve（CN54123A）

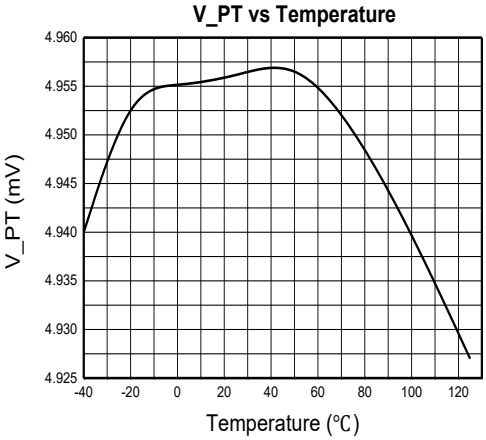
(V_{IN}=4.5V, T_A=25°C, unless otherwise specified.)

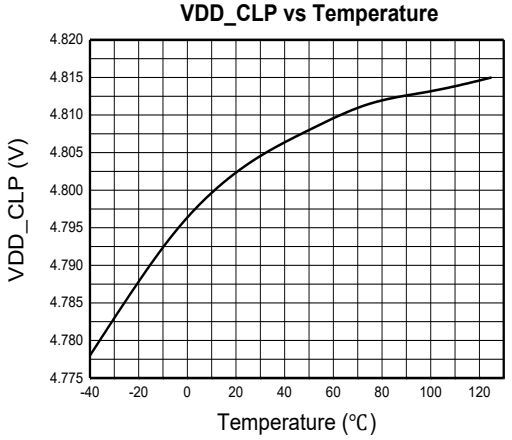












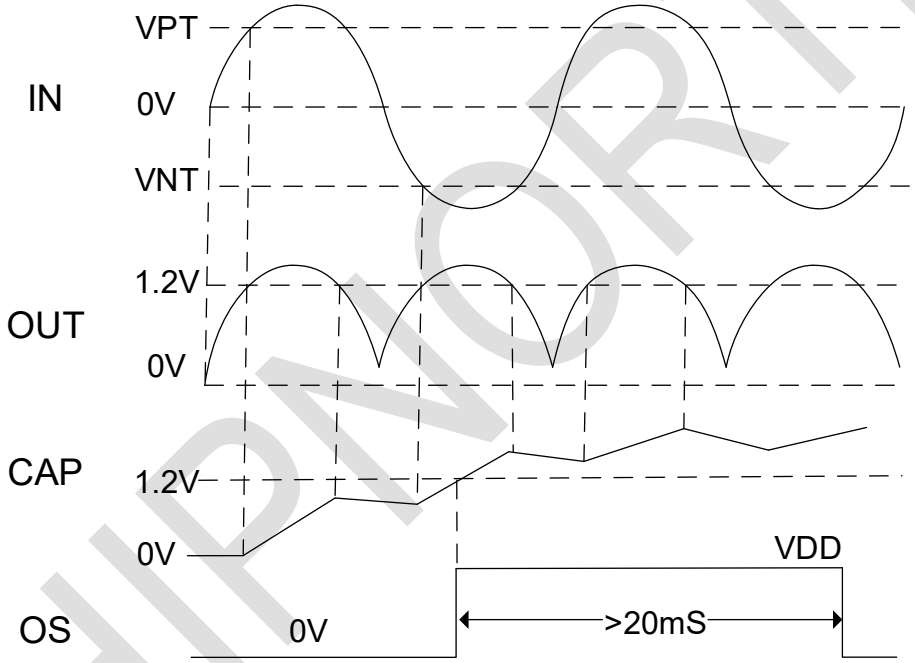
11 Detailed Description

11.1 Overview

The CN54123A/B/C/D is used to detect the leakage on the live and neutral lines. When a leakage signal is generated, the ZCT detects the leakage signal and the secondary coil outputs an inductive signal as the input of the main chip for the Earth leakage circuit breaker. The chip can detect the residual current of type AC. When the RMS value of the leakage current is greater than the rated current (RMS) specified by the Earth leakage circuit breaker, the OS generates an action level with a minimum pulse width of 20ms, which drives the SCR to turn on.

11.2 Control Mechanism

The figure below is an operation diagram of the CN54123A/B/C/D, detecting the leakage signal between OP1 and OP2, when the peak value of the input voltage signal exceeds 4.95mV, the output pin OS generates an action level, and the level pulse width is 20ms minimum, driving the external SCR to turn on.



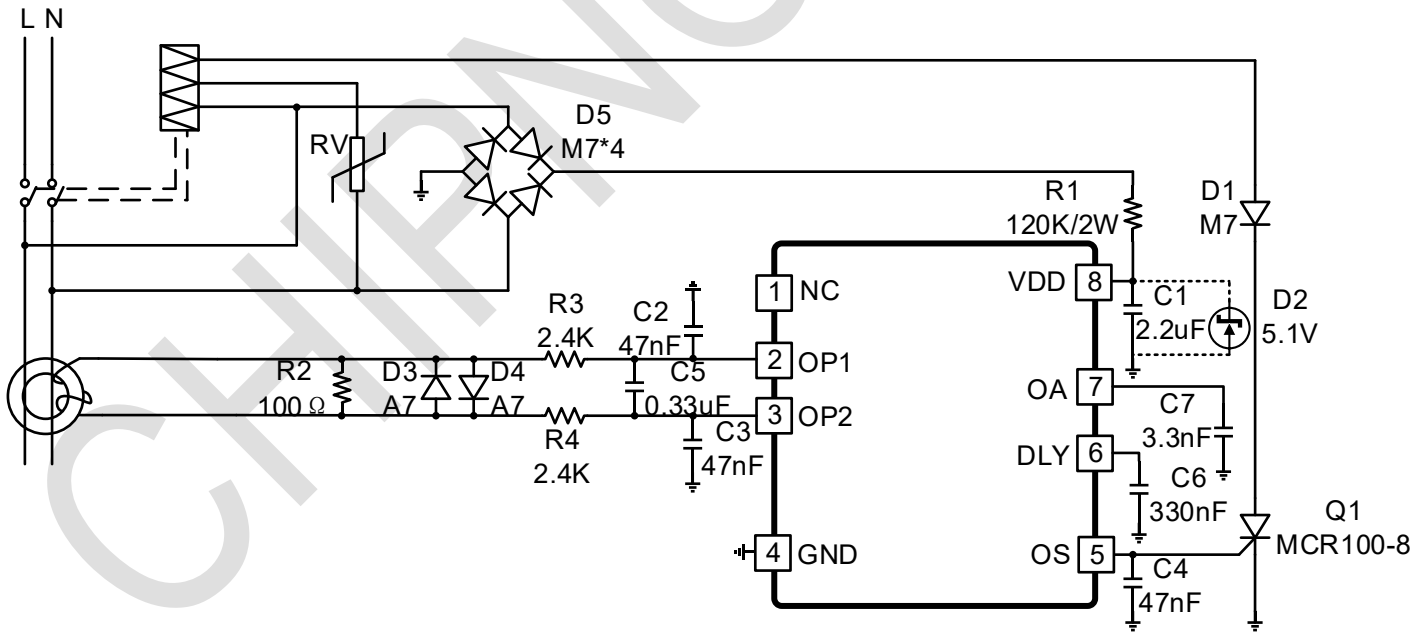
12 Application Information

12.1 CN54123A/B/C/D Selection Table

Part NO	I_OS	OS output	Applicable scenarios
CN54123A	1.7mA	When the leakage current occurs on the L and N lines,the OS outputs high until the leakage is removed.	AC input voltage range: 50V~380V(50/60Hz), full-bridge rectification , AC type leakage
CN54123B	1.7mA	When the leakage current occurs on the L and N lines,the OS outputs only one pulse level of at least 20ms.	AC input voltage range: 50V~380V(50/60Hz), full-bridge rectification , AC type leakage
CN54123C	0.2mA	When the leakage current occurs on the L and N lines，the OS outputs high until the leakage is removed.	AC input voltage range: 50V~380V(50/60Hz), half-bridge and full-bridge rectification , AC type leakage
CN54123D	0.2mA	When the leakage current occurs on the L and N lines,the OS outputs only one pulse level of at least 20ms.	AC input voltage range: 50V~380V(50/60Hz), half-bridge and full-bridge rectification , AC type leakage

12.2 Typical Application

The figure below shows a schematic diagram of CN54123A/B/C/D typical application circuit that can be used to evaluate its performance.



In the above application circuit diagram, T0 is the ZCT used to induce the leakage current on the power supply line, R2 is the leakage protection action sensitivity adjustment resistance, the value of the resistance is related to the leakage current required to act and the turn ratio of the ZCT,the action sensitivity inside the CN54123A/B/C/D is 4.95mV, then ideally

$$R_2 = \frac{4.95mV \times n \times k}{\sqrt{2} \times I_{\Delta n}}$$

- $I_{\Delta n}$ is the set threshold current for leakage action
- n is the number of turns of the zero-sequence current transformer T0
- k is the inductance coefficient of the current transformer

R1, C1 and the clamping circuit inside the CN54123A/B/C/D form the power supply circuit, the value of R1 needs to consider the power requirements under the condition of maximum working voltage and the minimum working voltage requirements. Under the condition that the minimum operating voltage is 50 V AC, the maximum clamping current of VDD is 50 mA, considering the heat generation,120kΩ/2W is recommended for R1 and 2.2uF/50V for C1.

C2 and C3 are common-mode filter capacitors, it is recommended that C2 and C3 use 47nF capacitors.

R3 and R4 are current-limiting resistors, and theoretically R3 and R4 are larger to protect the IC, but because the CN54123A/B/C/D uses a voltage amplifier internally, its impedance is limited, so it is recommended that the values of R3 and R4 should not exceed 2.4kΩ. At the same time, R3, R4 and C5 form a low-pass filter circuit, and R3*C5 is the frequency retort point (the retort frequency is 1kHz). It is recommended that the value of C5 should not be greater than 330 nF.

C4 filters the high-frequency interference noise that may occur in the circuit breaker, and avoids the false triggering of the SCR Q1 during the power-on process of the circuit breaker.

C6 is the CN54123A/B/C/D delay adjustment capacitor, when the absolute value voltage of the difference between OP1 and OP2 at the input end of the CN54123A/B/C/D is greater than 4.95mV, the output current of the CAP pin of the CN54123A/B/C/D charges C6, and when the voltage of C6 rises to 1.23V, the output of the OS pin of the CN54123A/B/C/D drives the pull-up driving current of the SCR, which is 230uA.

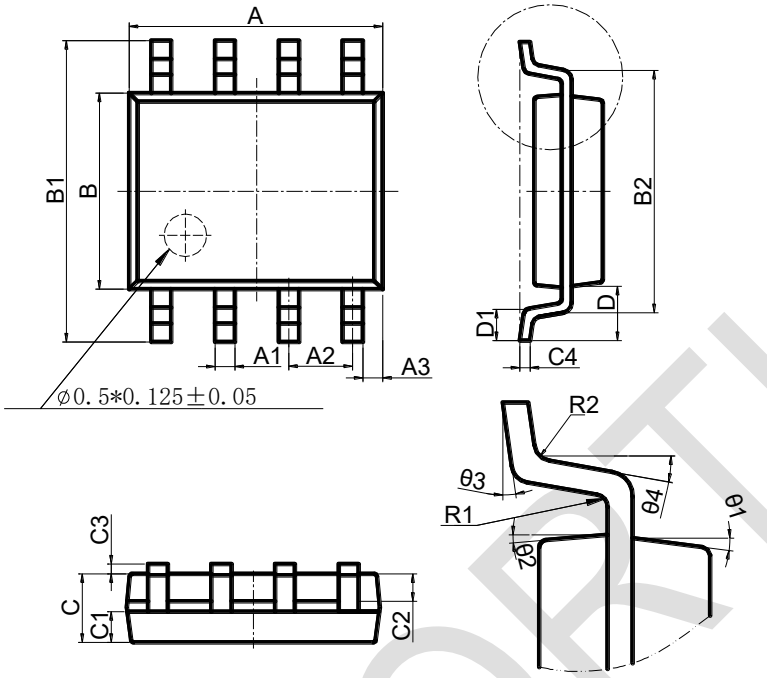
In normal operation, the clamping circuit inside the chip can ensure that the power supply voltage of the chip is below 5V, so as to ensure the normal operation of the chip. However, when a high voltage is directly applied to the power supply pin of the chip when the chip is not working normally (for example, the voltage on the live capacitor C1 is directly applied to the power pin of the chip during the placement process), the chip is at risk of being damaged by the high voltage because the internal clamping circuit has not been started normally. The function of the Zener Diode D2 is to avoid damage to the chip caused by the live capacitor during the production process, and if the selected capacitor C1 has released the residual charge before leaving the factory or before the SMT, the Zener Diode D2 can be omitted.

12.3 Working waveform

AC Type(CN54123A)

13 Package Information

SOP8L



Symbol	MILLIMETER		Symbol	MILLIMETER	
	MIN	MAX		MIN	MAX
A	4.80	5.00	C3	0.05	0.20
A1	0.356	0.456	C4	0.203	0.233
A2	1.27TYP		D	1.05TYP	
A3	0.345TYP		D1	0.40	0.80
B	3.80	4.00	R1	0.20TYP	
B1	5.80	6.20	R2	0.20TYP	
B2	5.00TYP		θ1	17°TYP4	
C	1.30	θ2	θ2	13°TYP4	
C1	0.55	0.65	θ3	0°~8°	
C2	0.55	0.65	θ4	4°~12°	

14 Important Statement

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