

# LCP1531

### Programmable transient voltage suppressor for SLIC protection

### **Features**

- Dual programmable transient suppressor
- Wide negative firing voltage range:  $V_{Gn} = -175 V max.$
- Low dynamic switching voltages:  $V_{FP}$  and  $V_{DGI}$
- Low gate triggering current: I<sub>GT</sub> = 5 mA max
- Peak pulse current: I<sub>PP</sub> = 37.5 A (5/310 µs)
- Holding current: I<sub>H</sub> = 150 mA min.
- Low space consuming package

#### **Benefits**

- A Trisil<sup>TM</sup> is not subject to ageing and provides a fail-safe mode in short circuit for better protection.
- Trisils are used to help equipment to meet various standards such as YDT695, and ITU-T K20/21.
- Trisils are UL94 V0 resin approved and are UL497B approved [file: E136224]).

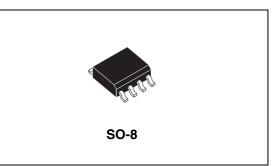
### Description

These devices are ideally suited to meet the protection requirement of VoIP SLICs located in next generation residential gateways. They can be used for protecting any ringing SLIC since they meet the protection standard requirements.

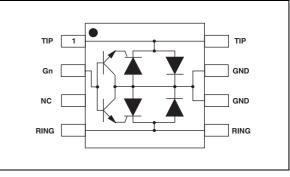
Positive overvoltages are clamped by 2 diodes. Negative surges are suppressed by 2 thyristors, their breakdown voltage being referenced to -V<sub>BAT</sub> through the gate.

These components present a very low gate triggering current (IGT) to reduce the current consumption on printed circuit board during the firing phase.

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LCP1531 functional diagram Figure 1.



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## 1 Characteristics

Standard	Peak surge voltage (V)	Voltage waveform	Required peak current (A)	Current waveform	Minimum serial resistor to meet standard (Ω)
	2500	2/10 µs	500	2/10 µs	23
GR-1089 Core First level	1000	10/1000 µs	100	10/1000 µs	30
GR-1089 Core Second level	5000	2/10 µs	500	2/10 µs	46
GR-1089 Core Intra-building	1500	2/10 µs	100	2/10 µs	1.7
ITU-T-K20/K21	6000 1500	10/700 µs	150 37.5	5/310 µs	120 0
ITU-T-K20 (IEC 61000-4-2)	8000 15000	1/60 ns		ct discharge discharge	0 0
	4000	10/700 µs	100	5/310 µs	67
IEC 61000-4-5	4000	1.2/50 µs	100	8/20 µs	27
TIA-968-A,	1500	10/160 µs	200	10/160 µs	26
lightning surge type A	800	10/560 µs	100	10/560 µs	17
TIA-968-A, lightning surge type B	1500	9/720 µs	37.5	5/320 µs	0

#### Table 2. Thermal resistance

Symbol	Parameter	Value	Unit
R <sub>th(j-a)</sub>	Junction to ambient	120	°C/W

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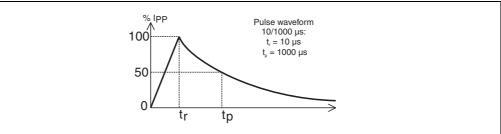
Symbol	Parameter	Value	Unit	
		10/1000 µs	25	
		8/20 µs	60	
		10/560 µs	32	
I <sub>PP</sub>	eak pulse current	5/310 µs	37.5	А
		10/160 µs	45	
		1/20 µs	60	
		2/10 µs	90	
		t = 20 ms	16	
I <sub>TSM</sub>	Non-repetitive surge peak on-state current	t = 200 ms	9	Α
	(50 Hz sinusoidal)	t = 1 s	6	
I <sub>GSM</sub>	Maximum gate current (50 Hz sinusoidal) t = 10 ms		2	А
V <sub>Gn</sub>	Negative battery voltage range	-175	V	
T <sub>stg</sub>	Storage temperature range		-55 to +150	•
Тj	Operating junction temperature range		-40 to +150	°C
ΤL	Maximum lead temperature for soldering during 10 s. 2			°C

Table 3.Absolute ratings (T<sub>amb</sub> = 25 °C, unless otherwise specified)

#### Figure 2. Electrical characteristics (definitions)

Symb	ol	Parameter		<b>•</b>	
I <sub>GT</sub>	=	Gate triggering current			
$V_{FP}$	=	Peak forward voltage LINE / GND			
V <sub>GT</sub>	=	Gate triggering voltage			
V <sub>F</sub>	=	Forward drop voltage LINE /GND			
I <sub>RG</sub>	=	Reverse leakage current GATE / LINE			
I <sub>H</sub>	=	Holding current			
$V_{RG}$	=	Reverse voltage GATE / LINE	VR	VF	
$V_{DGL}$	=	Dynamic switching voltage GATE / LINE		VF	►V
I <sub>PP</sub>	=	Peak pulse current		IR	
I <sub>B</sub>	=	Breakdown current	I		
V <sub>F</sub>	=	Forward drop voltage LINE / GND		IH IH	
C	=	Capacitance LINE /GND			
				IPP	





Symbol	Test conditions			Max.	Unit
V <sub>F</sub>	I <sub>F</sub> = 5 A		t = 500 μs	3	V
V <sub>FP</sub>	10/700 μs	V <sub>PP</sub> = 1.5 kV	R <sub>S</sub> = 15 Ω	5	V

Table 4. Parameters related to the diode LINE / GND ( $T_{amb} = 25 \degree C$ )

#### Table 5.Parameters related to the protection thyristors ( $T_{amb} = 25 \ ^{\circ}C$ )

Symbol	Test conditions	Min.	Max.	Unit
I <sub>GT</sub>	V <sub>LINE</sub> = -48 V	0.1	5	mA
Ι <sub>Η</sub>	V <sub>Gn</sub> = -48 V	150		mA
I <sub>RG</sub>	V <sub>RG</sub> = -75 V		5	μA
V	V <sub>Gn</sub> = -48 V <sup>(1)</sup>			
V <sub>DGL</sub>	10/700 $\mu s$ $V_{PP}$ = 1.5 kV $R_{S}$ = 15 $\Omega$ $I_{PP}$ = 27.5 A		7	V

1. The oscillations with a time duration lower than 50 ns are not taken into account.

#### Table 6. Parameters related to diode and protection thyristors ( $T_{amb} = 25 \ ^{\circ}C_{,}$ )

Symbol	Test conditions	Тур.	Max.	Unit	
I <sub>R</sub>	$V_{Gn / LINE} = -1 V V_{RM} = -75 V$	T <sub>j</sub> = 25 °C		5	μA
С	$V_{LINE}$ = -50 V, $V_{RMS}$ = 1 V, F = 1 MHz $V_{LINE}$ = -2 V, $V_{RMS}$ = 1 V, F = 1 MHz		15 35		pF

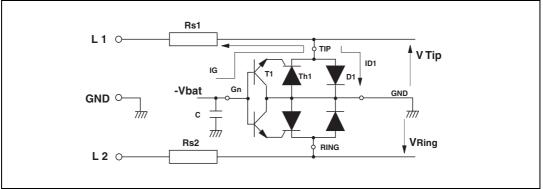
#### Table 7. Recommended gate capacitance

Symbol	Component	Min.	Тур.	Max.	Unit
C <sub>G</sub>	Gate decoupling capacitance		220		nF



### 2 Technical information





*Figure 4.* shows the classical protection circuit using the LCP1531 crowbar concept. This topology has been developed to protect the new high voltage SLICs. It allows to program the negative firing threshold while the positive clamping value is fixed at GND.

When a negative surge occurs on one wire (L1 for example) a current IG flows through the base of the transistor T1 and then injects a current in the gate of the thyristor Th1. Th1 fires and all the surge current flows through the ground. After the surge when the current flowing through Th1 becomes less negative than the holding current  $I_H$ , then Th1 switches off.

When a positive surge occurs on one wire (L1 for example) the diode D1 conducts and the surge current flows through the ground.

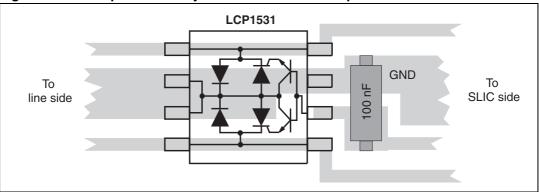


Figure 5. Example of PCB layout based on LCP1531 protection

*Figure 5.* shows the classical PCB layout used to optimize line protection.

The capacitor C is used to speed up the crowbar structure firing during the fast surge edges.

This allows minimization of the dynamic breakover voltage at the SLIC Tip and Ring inputs during fast strikes. Note that this capacitor is generally present around the SLIC -  $V_{bat}$  pin.

So to be efficient it has to be as close as possible from the LCP1531 Gate pin and from the reference ground track (or plan) (see *Figure 5*.). The optimized value for C is 100 nF.

The series resistors Rs1 and Rs2 designed in *Figure 4.* represent the fuse resistors or the PTC which are mandatory to withstand the power contact or the power induction tests



imposed by the various country standards. Taking into account this fact the actual lightning surge current flowing through the LCP1531 is equal to:

$$I_{surge} = V_{surge} / (R_g + R_s)$$
  
With:  
 $V_{surge} = peak surge voltage imposed by the standard.$   
 $R_g = series resistor of the surge generator$ 

 $R_s$  = series resistor of the line card (e.g. PTC)

The LCP1531 is particularly optimized for the new telecom applications such as the fiber in the loop, the WLL, the remote central office. In this case, the operating voltages are smaller than in the classical system. This makes the high voltage SLICs particularly suitable.

The schematics of *Figure 6*. gives the most frequent topology used for these applications.

Figure 6. Protection of high voltage SLIC

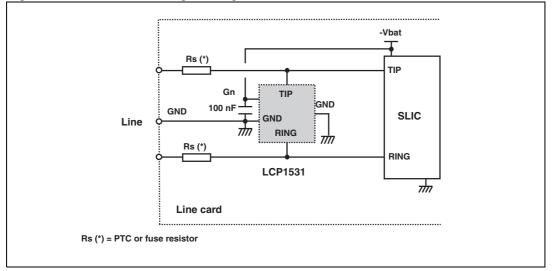
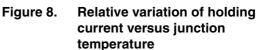
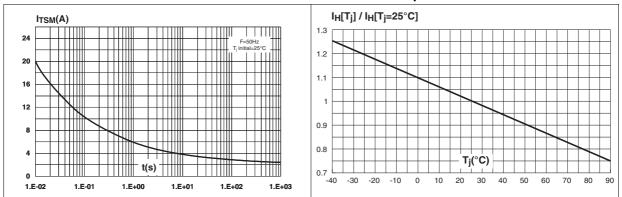


Figure 7. Surge peak current versus overload duration







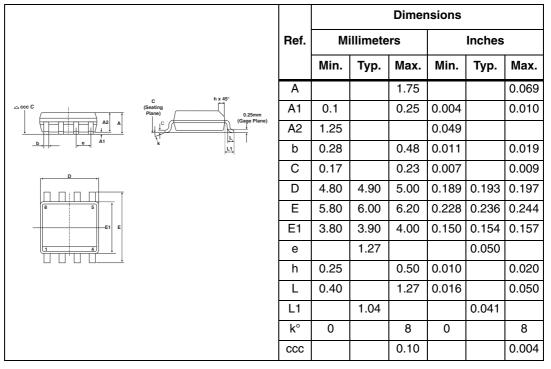
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### 3 Package information

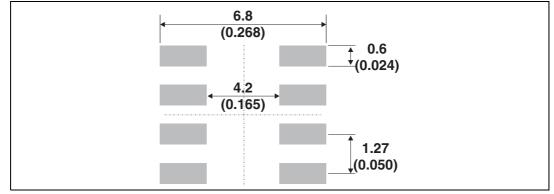
- Epoxy meets UL94, V0
- Lead-free package

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK<sup>®</sup> is an ST trademark.

Table 8. SO-8 dimensions



#### Figure 9. SO-8 footprint (dimensions in mm)



## 4 Ordering information

#### Table 9.Ordering information

Order code	Marking	Package	Weight	Base qty	Delivery mode
LCP1531RL	CP1531RL CP153		0.08 g	2500	Tape and reel

## 5 Revision history

#### Table 10. Document revision history

Date	Revision	Changes
23-Mar-2007	1	First issue.
10-Apr-2008	2	Reformatted for current standards. Changed gate capacitance from 220 nF to 100 nF.
10-Aug-2011	3	Updated standards in <i>Table 1</i> .
23-Feb-2012	4	Standardized nomenclature for Gn.



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Doc ID 13397 Rev 4