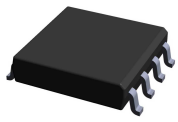
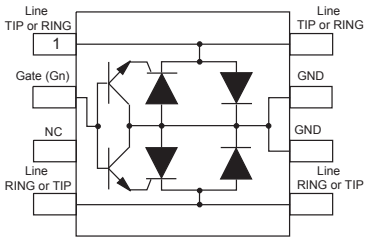
LCP1521S

Datasheet

Programmable transient voltage suppressor for SLIC protection



SO-8



Product status link
LCP1521S

Features

- Programmable transient suppressor
- Wide negative firing voltage range:
  - V_{Gn} = -175 V max.
- Low dynamic switching voltages:
  - V_{FP} and V_{DGL}
- Low gate triggering current: I_{GT} = 5 mA max.
- Peak pulse current: I_{PP} = 40 A (5/310 µs)
- Holding current: I_H = 150 mA min.
- **Benefits**:
  - A Trisil is not subject to ageing and provides a fail-safe mode in short circuit for a better protection.
  - Trisils are used to help equipment to meet various standards such as UL60950, IEC 60950 / CSA C22.2, UL1459 and TIA-968-A (formerly FCC part 68)
  - Trisils have UL94 V0 resin approved (Trisils are UL497B approved - file: E136224)

Description

These devices have been especially designed to protect new high voltage, as well as classical SLICs, against transient overvoltages.

Positive overvoltages are clamped by 2 diodes. Negative surges are suppressed by 2 thyristors, their breakdown voltage being referenced to $-V_{BAT}$ through the gate.

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

1 Characteristics

Table 1. Standards compliance

Standard	Peak surge voltage (V)	Voltage waveform	Required peak current (A)	Current waveform	Minimum serial resistor to meet standard (Ω)
GR-1089 core first level	2500 1000	2/10 µs 10/1000 µs	500 100	2/10 µs 10/1000 µs	12 24
GR-1089 core second level	5000	2/10 µs	500	2/10 µs	24
GR-1089 core intra-building	1500	2/10 µs	100	2/10 µs	0
ITU-T-K20/K21	6000 1500	10/700 µs	150 37.5	5/310 µs	110 0
ITU-T-K20 (IEC 61000-4-2)	8000 15000	1/60 ns	ESD contact discharge ESD air discharge		0 0
IEC 61000-4-5	4000 4000	10/700 µs 1.2/50 µs	100 100	5/310 µs 8/20 µs	60 0
TIA-968-A, lightning surge type A	1500 800	10/160 µs 10/560 µs	200 100	10/160 µs 10/560 µs	22.5 15
TIA-968-A, lightning surge type B	1000	9/720 µs	25	5/320 µs	0

Table 2. Thermal resistance

Symbol	Parameter	Value	Unit
$R_{th(j-a)}$	Junction to ambient	120	°C/W

Table 3. Absolute ratings (T_{amb} = 25 °C)

Symbol	Parameter			Value	Unit
I_{pp}	Peak pulse current[1]	Telcordia GR-1089-CORE Issue 6, May2011, section 4	10/1000 µs	30	A
		TIA-968-A, lightning surge type A	10/560 µs	35	
		ITU-T K20/21/44/45, (10/700 µs open circuit voltage waveshape)	5/310 µs	40	
		TIA-968-A, lightning surge type A	10/160 µs	50	
		IEC 61000-4-5, (1.2/50 µs open circuit waveshape) with 10 Ω	4/30 µs	110	
		ITU-T K20/21/44/45, (1.2/50 µs open circuit voltage waveshape)	8/20 µs	120	
		Telcordia GR-1089-CORE Issue 6, (2/10 µs open circuit waveshape)	2/10 µs	150	
I_{TSM}	Non repetitive surge peak on-state current (50 Hz sinusoidal)		t = 20 ms t = 200 ms t = 1 s	18 10 7	A
V_{Gn}	Negative battery voltage range		-40 °C < T_{amb} < +85 °C	-175	V
T_{stg}	Storage junction temperature range			-55 to + 150	°C
T_j	Maximum operating junction temperature range				
T_L	Maximum temperature for soldering during 10 s			260	°C

1. *The rated current values may be applied either to the Ring to GND or to the Tip to GND terminal pairs. Additionally, the four terminal pairs may have their rated current values applied simultaneously (in this case the GND terminal current will be four times the rated current value of an individual terminal pair). Both GND pins must be connected to GND.*

Figure 1. Electrical characteristics (definitions)

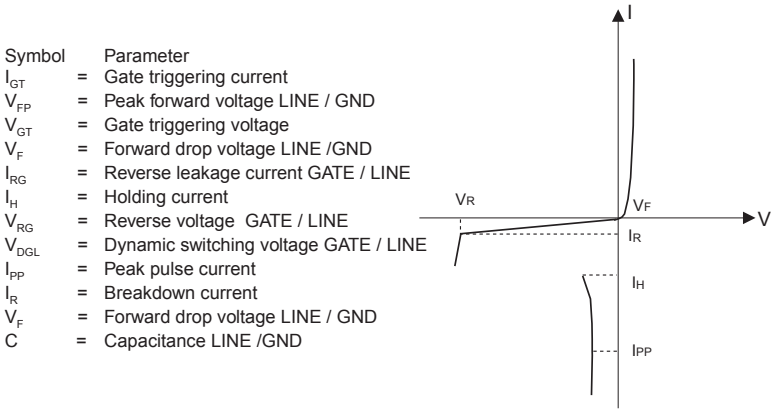


Figure 2. Pulse waveform

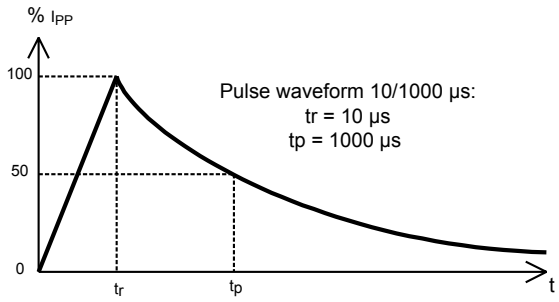


Table 4. Parameters (T_j = 25 °C, unless otherwise specified)

Symbol	Parameter					Min.	Typ.	Max.	Unit
I_{GT}	V_{LINE} = -48 V					0.1		5	mA
I_H	V_{Gn} = -48 V					150			mA
V_{GT}	at I_{GT}							2.5	V
I_{RG}	V_{RG} = -175 V				T_j = 25 °C			5	µA
	V_{RG} = -175 V				T_j = 85 °C			50	
V_{DGL} (1)	V_{Gn} = -48 V	10/700 µs	1.5 kV	R_S = 10 Ω	I_{PP} = 30 A			7	V
		1.2/50 µs	1.5 kV	R_S = 10 Ω	I_{PP} = 30 A			10	
		2/10 µs	2.5 kV	R_S = 62 Ω	I_{PP} = 38 A			25	
V_F	I_F = 5 A		t = 500 µs					3	V
V_{FP}	10/700 µs			1.5 kV	R_S = 10 Ω			5	V
	1.2/50 µs			1.5 kV	R_S = 10 Ω			9	
	2/10 µs			2.5 kV	R_S = 62 Ω			30	
I_R	$V_{Gn\ /\ LINE}$ = -1 V, V_{LINE} = -175 V				T_j = 25 °C			5	µA
	$V_{Gn\ /\ LINE}$ = -1 V, V_{LINE} = -175 V				T_j = 85 °C			50	
C	V_{LINE} = -50 V, V_{RMS} = 1 V, f = 1 MHz						15		pF
	V_{LINE} = -2 V, V_{RMS} = 1 V, f = 1 MHz						35		

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

Table 5. Recommended gate capacitance

Symbol	Parameter	Min.	Typ.	Max.	Unit
C_G	Gate decoupling capacitance	100	220		nF

2 Technical information

Figure 3. LCP concept behavior

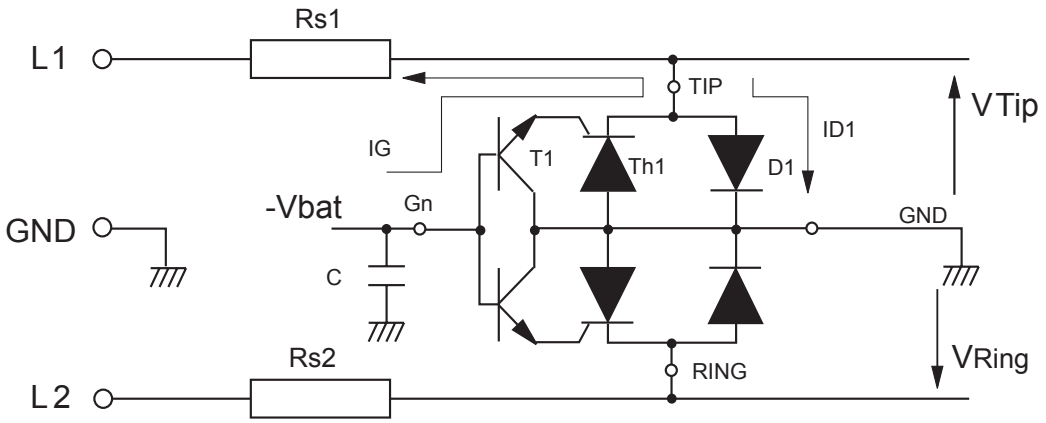


Figure 3 shows the classical protection circuit using the LCP crowbar concept. This topology has been developed to protect the new high voltage SLICs. It allows to program the negative firing threshold while the positive clamping value is fixed at GND.

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 IH, 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 4. Example of PCB layout based on LCP1521S protection

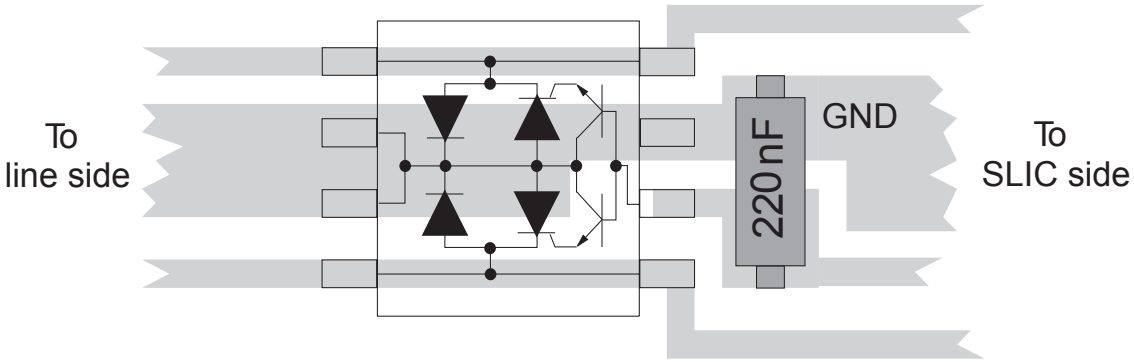


Figure 4 shows the classical PCB layout used to optimize line protection.

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 LCP Gate pin and from the reference ground track (or plan) (see Figure 4). The optimized value for C is 220 nF.

The series resistors Rs1 and Rs2 designed in Figure 3 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 LCP is equal to:

- 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)

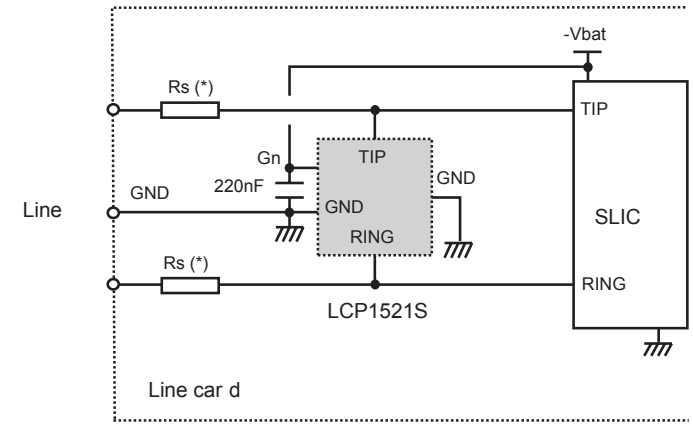
E.g. For a line card with 30 Ω of series resistors which has to be qualified under GR1089 core 1000V 10/1000 µs surge, the actual current through the LCP is equal to:

- I_{surge} = 1000 / (10 + 30) = 25 A

The LCP 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 5 give the most frequent topology used for these applications.

Figure 5. Protection of high voltage SLIC



Rs (*) = PTC or fuse resistor

Figure 6. Surge peak current versus duration

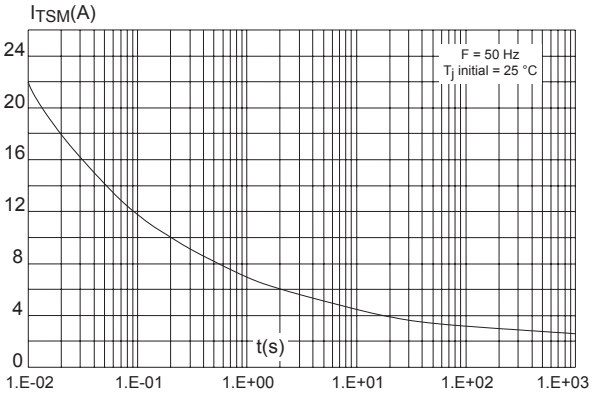
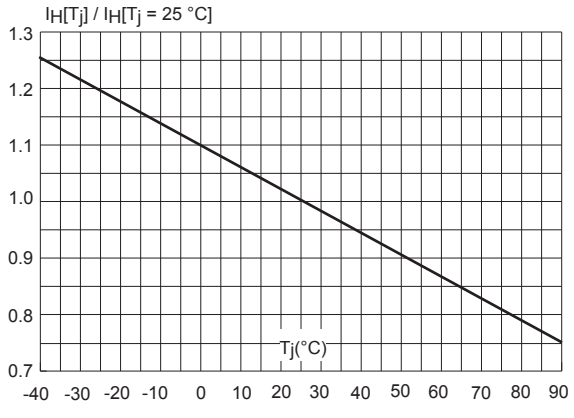


Figure 7. Relative variation of holding current versus junction temperature



3 Package information

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

3.1 SO-8 package information

Figure 8. SO-8 package outline

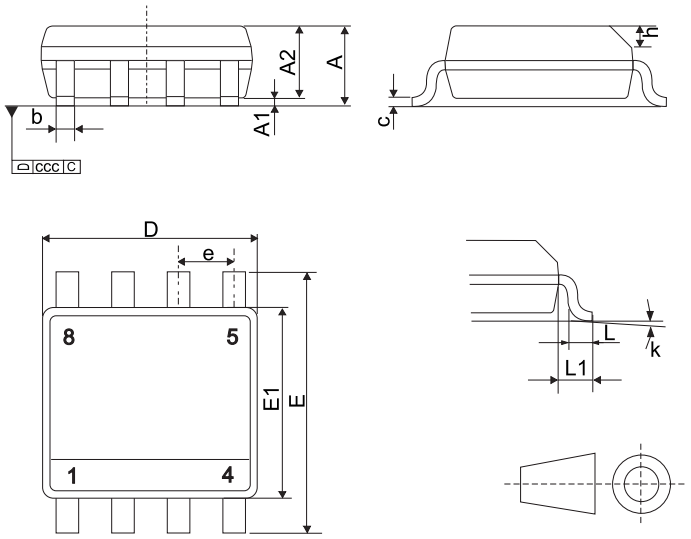


Table 6. SO-8 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
A1	0.1		0.25	0.004		0.010
A2	1.25			0.049		
b	0.31		0.51	0.012		0.020
c	0.10		0.25	0.004		0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.154	0.157
e		1.27			0.050	
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.05
L1		1.04			0.041	
k°	0		8	0		8
ccc			0.10			0.004

Figure 9. Footprint recommendations, dimensions in mm (inches)

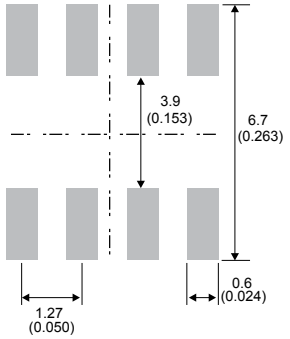
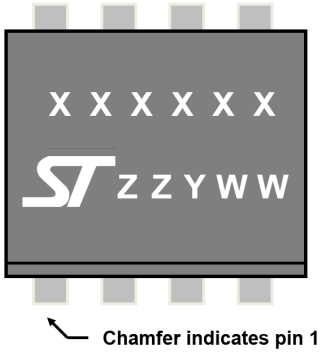


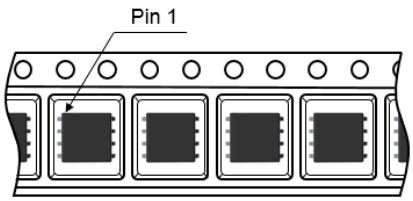
Figure 10. Marking layout (refer to ordering information table for marking)



XXXXX : Marking
ZZ : Manufacturing location
Y : Year
WW : week

Chamfer indicates pin 1

Figure 11. Package orientation in reel



Taped according to EIA-481
Note: Pocket dimensions are not on scale
Pocket shape may vary depending on package

Figure 12. Tape and reel orientation

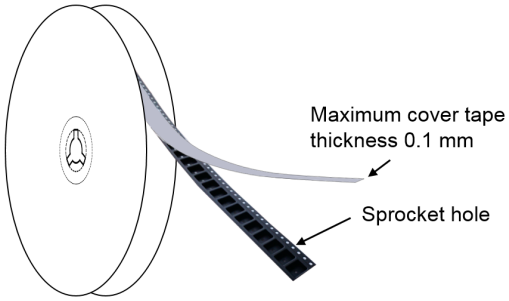


Figure 13. Reel dimensions (mm)

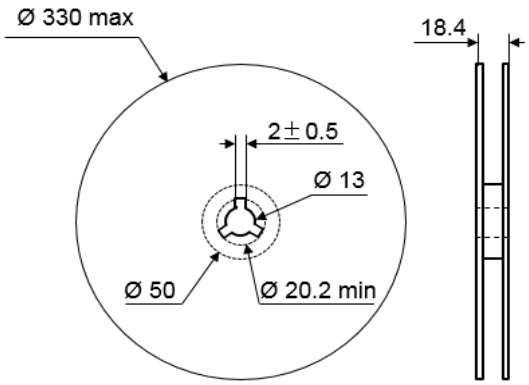


Figure 14. Inner box dimensions (mm)

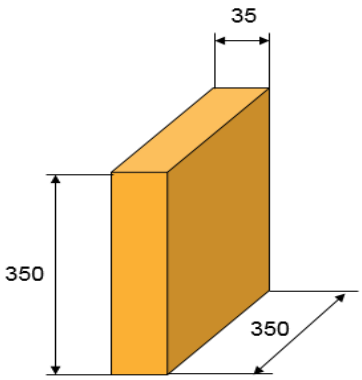
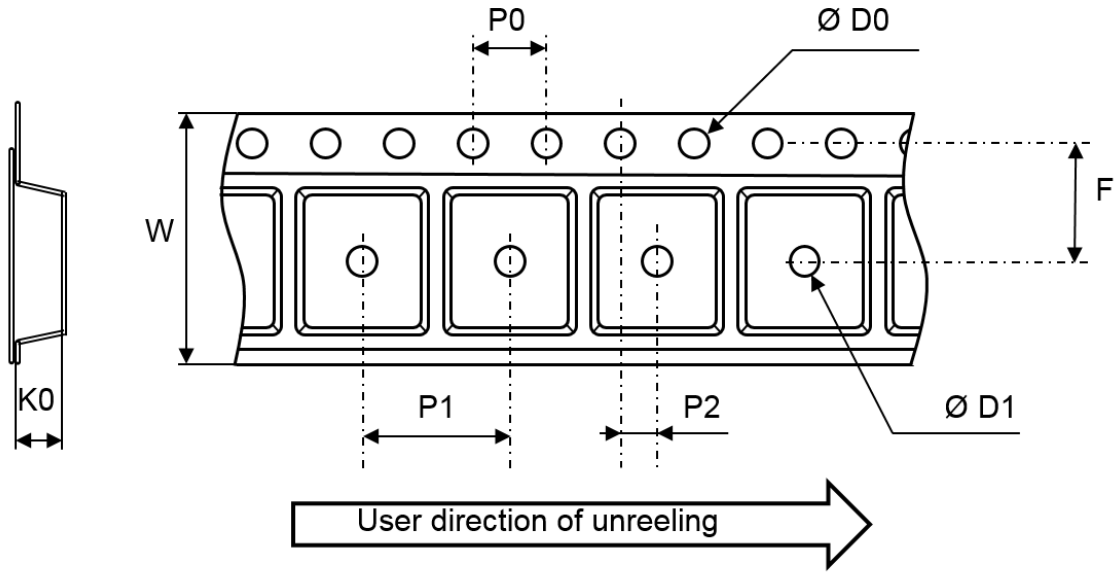


Figure 15. **Tape and reel outline**

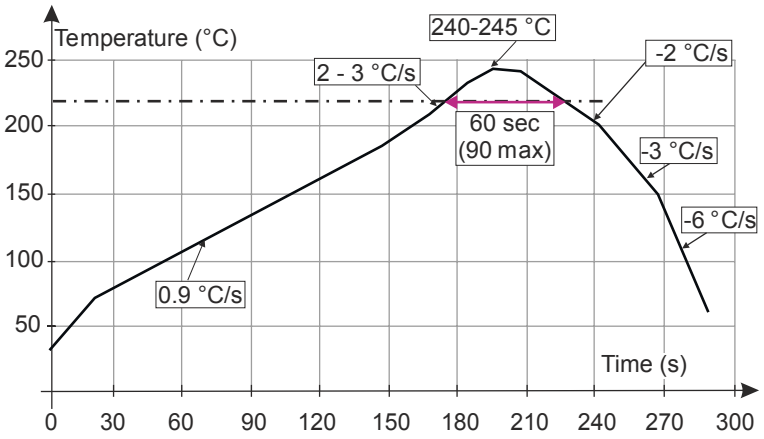


Note: Pocket dimensions are not on scale
Pocket shape may vary depending on package

Table 7. **Tape and reel mechanical data**

Ref.	Dimensions		
	Millimeters		
	Min.	Typ.	Max.
P0	3.9	4	4.1
P1	7.9	8	8.1
P2	1.95	2	2.05
ØD0	1.45	1.5	1.6
ØD1	1.6		
F	5.45	5.5	5.55
K0	2.5	2.6	2.7
W	11.7	12	12.3

Figure 16. ST ECOPACK recommended soldering reflow profile for PCB mounting



Note: Minimize air convection currents in the reflow oven to avoid component movement. Maximum soldering profile corresponds to the latest IPC/JEDEC J-STD-020.

4 Ordering information

Table 8. **Ordering information**

Order code	Marking	Package	Weight	Base qty.	Delivery mode
LCP1521SRL	CP152S	SO-8	0.08 g	2500	Tape and reel

Revision history

Table 9. **Document revision history**

Date	Revision	Changes
20-Nov-2009	1	First issue.
23-Feb-2012	2	Standardized nomenclature for Gn.
15-Nov-2013	3	Updated Figure 9.
10-Apr-2015	4	Updated Figure 1, Figure 10 and package view. Added Figure 11. Updated Table 3 and Table 7.
02-Jul-2015	5	Updated package information.
08-Jul-2015	6	Updated Figure 9.
12-Dec-2017	7	Updated Table 3: "Absolute ratings (Tj = 25 °C, unless otherwise specified)" and Section 3: "Package information".
25-Jul-2019	8	Updated Figure 10.

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LCP1521S LCP1521SRL