

## Trisil™ for telecom equipment protection

### Features

- Bidirectional crowbar protection
- Voltage range from 8 V to 400 V
- Low capacitance from 20 pF to 45 pF @ 2 V
- Low leakage current:  $I_R = 2 \mu\text{A}$  max
- Holding current:  $I_H = 150 \text{ mA}$  min.
- Repetitive peak pulse current:  
 $I_{PP} = 100 \text{ A}$  (10/1000  $\mu\text{s}$ )

### Benefits

- Trisils are not subject to ageing and provide a fail safe mode in short circuit for better protection.
- Helps equipment meet main standards such as UL60950, IEC 950 / CSA C22.2 and UL1459.
- Epoxy meets UL94, V0.
- Package is JEDEC registered (DO-214AA).

### Complies with the following standards

- GR-1089 Core
- ITU-T-K20/K21
- IEC 61000-4-5
- IEC 61000-4-2 level 4
- TIA/EIA IS-968
- UL497B recognized, UL file E136224

### Applications

Any sensitive equipment requiring protection against lightning strikes and AC power faults. These devices are dedicated to central office protection as they comply with the most stressful standards. Their low capacitances make them suitable for xDSL.



### Description

The SMP100LC is a series of low capacitance transient surge arrestors designed for the protection of high data rate communication equipment. The low capacitance of the devices avoids any distortion of the signal and is compatible with digital transmission line cards (xDSL, ISDN...).

SMP100LC series tested and confirmed compatible with Cooper Bussmann Telecom Circuit Protector TCP 1.25A.

The SMP100LC-xxx with the fuse TCP1.25A or TCP2A is compliant with Telcordia GR1089 (lightning and AC power fault tests), ITU-T K20/K21 (lightning and AC power fault tests), TIA/EIA-IS-968 (formerly FCC Part 68 lightning tests), and UL60950 (AC power fault tests). The use of the TCP1.25A allows the SMP100LC-xxx to be safe for the 2nd level (B criteria) AC power fault tests.

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# 1 Characteristics

**Table 1. In compliance with the following standards**

| Standard                                      | Peak surge voltage (V) | Waveform voltage | Required peak current (A) | Current waveform | Minimum serial resistor to meet standard ( $\Omega$ ) |
|-----------------------------------------------|------------------------|------------------|---------------------------|------------------|-------------------------------------------------------|
| <b>GR-1089 Core First level</b>               | 2500                   | 2/10 $\mu$ s     | 500                       | 2/10 $\mu$ s     | 0                                                     |
|                                               | 1000                   | 10/1000 $\mu$ s  | 100                       | 10/1000 $\mu$ s  | 0                                                     |
| <b>GR-1089 Core Second level</b>              | 5000                   | 2/10 $\mu$ s     | 500                       | 2/10 $\mu$ s     | 0                                                     |
| <b>GR-1089 Core Intra-building</b>            | 1500                   | 2/10 $\mu$ s     | 100                       | 2/10 $\mu$ s     | 0                                                     |
| <b>ITU-T-K20/K21</b>                          | 6000                   | 10/700 $\mu$ s   | 150                       | 5/310 $\mu$ s    | 0                                                     |
|                                               | 1500                   |                  | 37.5                      |                  | 0                                                     |
| <b>ITU-T-K20 (IEC61000-4-2)</b>               | 8000                   | 1/60 ns          | ESD contact discharge     |                  | 0                                                     |
|                                               | 15000                  |                  | ESD air discharge         |                  | 0                                                     |
| <b>IEC61000-4-5</b>                           | 4000                   | 10/700 $\mu$ s   | 100                       | 5/310 $\mu$ s    | 0                                                     |
|                                               | 4000                   | 1.2/50 $\mu$ s   | 100                       | 8/20 $\mu$ s     | 0                                                     |
| <b>TIA/EIA IS-968, lightning surge type A</b> | 1500                   | 10/160 $\mu$ s   | 200                       | 10/160 $\mu$ s   | 0                                                     |
|                                               | 800                    | 10/560 $\mu$ s   | 100                       | 10/560 $\mu$ s   | 0                                                     |
| <b>TIA/EIA IS-968, lightning surge type B</b> | 1000                   | 9/720 $\mu$ s    | 25                        | 5/320 $\mu$ s    | 0                                                     |

**Table 2. Absolute ratings ( $T_{amb} = 25\text{ °C}$ )**

| Symbol    | Parameter                                                     | Value                 | Unit |
|-----------|---------------------------------------------------------------|-----------------------|------|
| $I_{PP}$  | Repetitive peak pulse current (see <a href="#">Figure 2</a> ) | 10/1000 $\mu\text{s}$ | 100  |
|           |                                                               | 8/20 $\mu\text{s}$    | 400  |
|           |                                                               | 10/560 $\mu\text{s}$  | 140  |
|           |                                                               | 5/310 $\mu\text{s}$   | 150  |
|           |                                                               | 10/160 $\mu\text{s}$  | 200  |
|           |                                                               | 1/20 $\mu\text{s}$    | 400  |
|           |                                                               | 2/10 $\mu\text{s}$    | 500  |
| $I_{FS}$  | Fail-safe mode: maximum current <sup>(1)</sup>                | 8/20 $\mu\text{s}$    | 5 kA |
| $I_{TSM}$ | Non repetitive surge peak on-state current (sinusoidal)       | t = 0.2 s             | 24   |
|           |                                                               | t = 1 s               | 15   |
|           |                                                               | t = 2 s               | 12   |
|           |                                                               | t = 15 mn             | 4    |
| $I^2t$    | $I^2t$ value for fusing                                       | t = 16.6 ms           | 20   |
|           |                                                               | t = 20 ms             | 21   |
| $T_{stg}$ | Storage temperature range                                     | -55 to 150            | °C   |
| $T_j$     | Operating junction temperature range                          | -40 to 150            |      |
| $T_L$     | Maximum lead temperature for soldering during 10 s.           | 260                   | °C   |

1. In fail safe mode, the device acts as a short circuit.

**Table 3. Thermal resistances**

| Symbol        | Parameter                                        | Value | Unit |
|---------------|--------------------------------------------------|-------|------|
| $R_{th(j-a)}$ | Junction to ambient (with recommended footprint) | 100   | °C/W |
| $R_{th(j-l)}$ | Junction to leads                                | 20    | °C/W |

**Figure 1. Electrical characteristics - definitions ( $T_{amb} = 25\text{ °C}$ )**



**Table 4. Electrical characteristics - values ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ )**

| Order code   | $I_{RM} @ V_{RM}$ |     | $I_R @ V_R$   |     | Dynamic $V_{BO}^{(1)}$ | Static $V_{BO} @ I_{BO}^{(2)}$ |      | $I_H^{(3)}$ | $C^{(4)}$ | $C^{(5)}$ |    |
|--------------|-------------------|-----|---------------|-----|------------------------|--------------------------------|------|-------------|-----------|-----------|----|
|              | max.              |     | max.          |     | max.                   | max.                           | max. | min.        | typ.      | typ.      |    |
|              | $\mu\text{A}$     | V   | $\mu\text{A}$ | V   | V                      | V                              | mA   | mA          | pF        | pF        |    |
| SMP100LC-8   | 2                 | 6   | 5             | 8   | 25                     | 15                             | 800  | 150         | 50 (typ.) | NA        | 75 |
| SMP100LC-25  |                   | 22  |               | 25  | 40                     | 35                             |      |             | NA        | 65        |    |
| SMP100LC-35  |                   | 32  |               | 35  | 55                     | 55                             |      |             | NA        | 55        |    |
| SMP100LC-65  |                   | 55  |               | 65  | 85                     | 85                             |      |             | 45        | 90        |    |
| SMP100LC-90  |                   | 81  |               | 90  | 120                    | 125                            |      |             | 40        | 80        |    |
| SMP100LC-120 |                   | 108 |               | 120 | 155                    | 150                            |      |             | 35        | 75        |    |
| SMP100LC-140 |                   | 126 |               | 140 | 180                    | 175                            |      |             | 30        | 65        |    |
| SMP100LC-160 |                   | 144 |               | 160 | 205                    | 200                            |      |             | 30        | 65        |    |
| SMP100LC-200 |                   | 180 |               | 200 | 255                    | 250                            |      |             | 30        | 60        |    |
| SMP100LC-230 |                   | 207 |               | 230 | 295                    | 285                            |      |             | 30        | 60        |    |
| SMP100LC-270 |                   | 243 |               | 270 | 345                    | 335                            |      |             | 30        | 60        |    |
| SMP100LC-320 |                   | 290 |               | 320 | 400                    | 390                            |      |             | 25        | 50        |    |
| SMP100LC-360 |                   | 325 |               | 360 | 460                    | 450                            |      |             | 25        | 50        |    |
| SMP100LC-400 |                   | 360 |               | 400 | 540                    | 530                            |      |             | 20        | 45        |    |

1. See [Figure 16: Test circuit 1 for Dynamic  \$I\_{BO}\$  and  \$V\_{BO}\$  parameters](#)
2. See [Figure 17: Test circuit 2 for  \$I\_{BO}\$  and  \$V\_{BO}\$  parameters](#)
3. See [Figure 18: Test circuit 3 for dynamic  \$I\_H\$  parameter](#)
4.  $V_R = 50\text{ V}$  bias,  $V_{RMS} = 1\text{ V}$ ,  $F = 1\text{ MHz}$
5.  $V_R = 2\text{ V}$  bias,  $V_{RMS} = 1\text{ V}$ ,  $F = 1\text{ MHz}$

Figure 2. Pulse waveform



Figure 3. Non repetitive surge peak on-state current versus overload duration



Figure 4. On-state voltage versus on-state current (typical values)



Figure 5. Relative variation of holding current versus junction temperature



Figure 6. Relative variation of breakover voltage versus junction temperature



Figure 7. Relative variation of leakage current versus junction temperature (typical values)



**Figure 8. Variation of thermal impedance junction to ambient versus pulse duration**



**Figure 9. Relative variation of junction capacitance versus reverse voltage applied (typical values)**



## 2 Application information

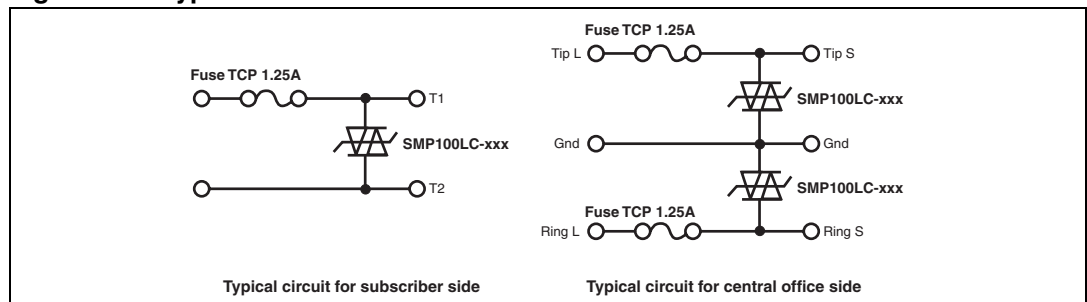
In wire line applications, analog or digital, both central office and subscriber sides have to be protected. This function is assumed by a combined series / parallel protection stage.

**Figure 10. Examples of protection stages for line cards**

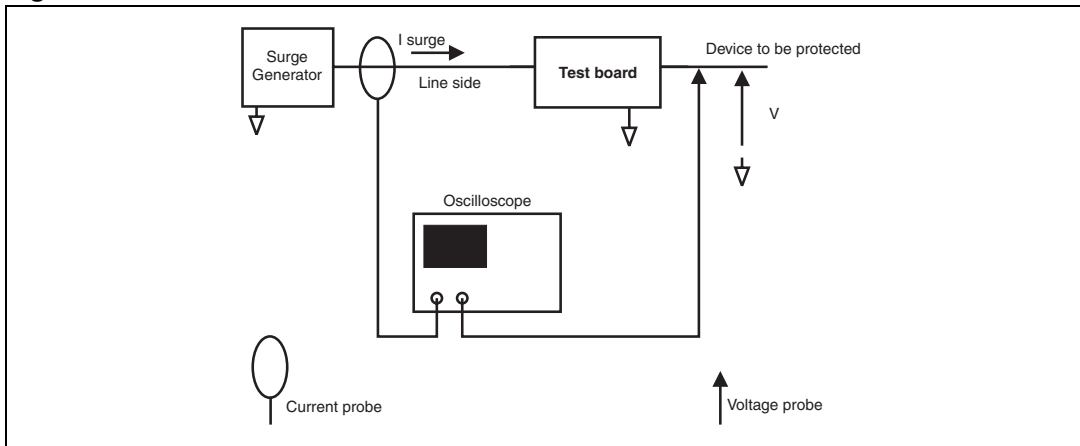


In such a stage, parallel function is assumed by one or several Trisil, and is used to protect against short duration surge (lightning). During this kind of surges the Trisil limits the voltage across the device to be protected at its break over value and then fires. The fuse assumes the series function, and is used to protect the module against long duration or very high current mains disturbances (50/60Hz). It acts by safe circuit opening. Lightning surge and mains disturbance surges are defined by standards like GR1089, TIA/EIA IS-968, ITU-T K20.

**Figure 11. Typical circuits**



**Figure 12. Test method of the board with fuse and Trisil**



These topologies, using SMP100LC from ST and TCP1.25A from Cooper Bussmann, have been functionally validated with a Trisil glued on the PCB. Following example was performed with SMP100LC-270 Trisil. For more information, see Application Note AN2064.

**Figure 13. Trisil turns on during lightning strike**



**Test conditions:**

2/10  $\mu$ s + and - 2.5 and 5 kV, 500 A (10 pulses of each polarity),  $T_{amb} = 25\text{ }^{\circ}\text{C}$

**Test result:**

Fuse and Trisil OK after test in accordance with GR1089 requirements.

**Figure 14. Trisil action while fuse remains operational**



**Test conditions:**

600 V, 3 A, 1.1 s (first level),  $T_{amb} = 25\text{ }^{\circ}\text{C}$

**Test result:**

Fuse and Trisil OK after test in accordance with GR1089 requirements.

**Figure 15. High current AC power test: the fuse acts like a switch by opening the circuit**



**Test conditions:**

277 V, 25 A (second level),  $T_{amb} = 25\text{ }^{\circ}\text{C}$

**Test result:**

Fuse safely opened and Trisil OK after test in accordance with GR1089 requirements.



Figure 16. Test circuit 1 for Dynamic  $I_{BO}$  and  $V_{BO}$  parameters



Figure 17. Test circuit 2 for  $I_{BO}$  and  $V_{BO}$  parameters



Figure 18. Test circuit 3 for dynamic  $I_H$  parameter



### 3 Ordering information scheme

Figure 19. Ordering information scheme



## 4 Package information

- Epoxy meets UL94, V0
- Lead-free package

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](http://www.st.com). ECOPACK® is an ST trademark.

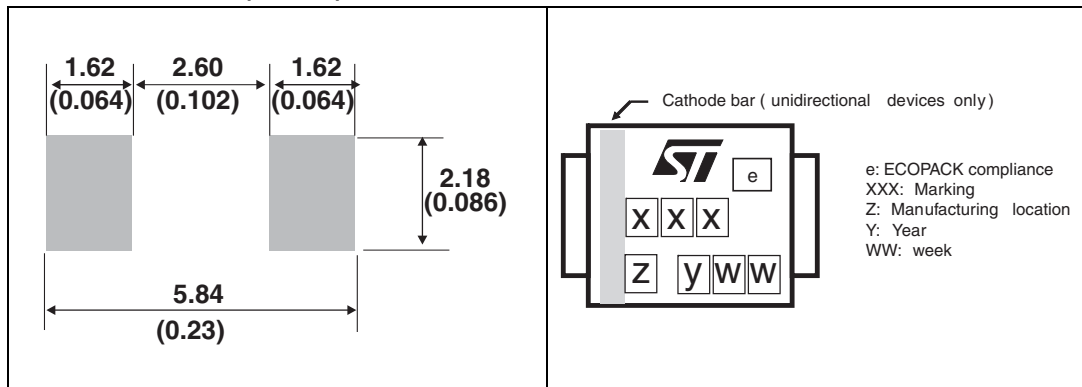
**Table 5. SMB dimensions**

| Ref. | Dimensions  |      |        |       |
|------|-------------|------|--------|-------|
|      | Millimeters |      | Inches |       |
|      | Min.        | Max. | Min.   | Max.  |
| A1   | 1.90        | 2.45 | 0.075  | 0.096 |
| A2   | 0.05        | 0.20 | 0.002  | 0.008 |
| b    | 1.95        | 2.20 | 0.077  | 0.087 |
| c    | 0.15        | 0.40 | 0.006  | 0.016 |
| E    | 5.10        | 5.60 | 0.201  | 0.220 |
| E1   | 4.05        | 4.60 | 0.159  | 0.181 |
| D    | 3.30        | 3.95 | 0.130  | 0.156 |
| L    | 0.75        | 1.50 | 0.030  | 0.059 |



**Figure 20. Footprint dimensions in mm (inches)**

**Figure 21. Marking layout<sup>(1)</sup>**



1. Marking layout can vary according to assembly location.

## 5 Ordering information

Table 6. Ordering information

| Order code   | Marking | Package | Weight | Base qty | Delivery mode |
|--------------|---------|---------|--------|----------|---------------|
| SMP100LC-8   | PL8     | SMB     | 98 mg  | 2500     | Tape and reel |
| SMP100LC-25  | L25     |         |        |          |               |
| SMP100LC-35  | L35     |         |        |          |               |
| SMP100LC-65  | L06     |         |        |          |               |
| SMP100LC-90  | L09     |         |        |          |               |
| SMP100LC-120 | L12     |         |        |          |               |
| SMP100LC-140 | L14     |         |        |          |               |
| SMP100LC-160 | L16     |         |        |          |               |
| SMP100LC-200 | L20     |         |        |          |               |
| SMP100LC-230 | L23     |         |        |          |               |
| SMP100LC-270 | L27     |         |        |          |               |
| SMP100LC-320 | L32     |         |        |          |               |
| SMP100LC-360 | L36     |         |        |          |               |
| SMP100LC-400 | L40     |         |        |          |               |

## 6 Revision history

Table 7. Document revision history

| Date        | Revision | Changes                                                                                                                                                   |
|-------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09-Nov-2004 | 9        | Absolute ratings values, table 3 on page 2, updated.                                                                                                      |
| 07-Dec-2004 | 10       | SMP100LC-320, SMP100LC-360 and SMP100LC-400 addition.                                                                                                     |
| 20-Jun-2005 | 11       | Telecom Circuit Protector added in <a href="#">Description</a> .                                                                                          |
| 05-Mar-2007 | 12       | Reformatted to current standards. SMB <a href="#">Package information</a> updated. Standards compliance paragraphs added to <a href="#">Description</a> . |
| 05-Jan-2010 | 13       | Corrected vertical axis labelling in <a href="#">Figure 8</a> .                                                                                           |
| 09-Feb-2012 | 14       | Added UL statement in <a href="#">Complies with the following standards</a> .                                                                             |

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