

# PROTECTION SCHEMATICS FOR SWITCHING SYSTEMS

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## 1. INTRODUCTION

The aim of this note is to summarize the major characteristics of a SLIC and to propose protection solutions for each configuration.

## 2. SLIC FUNCTION

### 2.1. Slic generalities :

The Slic function is defined by the acronym BORCHT :

- Battery feeding
- Overvoltage protection
- Ringing
- Signalling
- Codec
- Hybrid
- Test

The important parameters to define the OVERVOLTAGE PROTECTION are the battery feeding and the ringing signal.

### 2.1.A/ battery feeding :

This sub-function of the Slic is characterized by:

- The battery voltage typical value (generally between 45 and 65 V)
- The tolerance of the voltage value
- The possibility to switch from one value to another one (line cards designed to operate equally on normal and long lines)

### 2.1.B/ Ringing signal :

For the ringing, two parameters need to be taken into account :

- The voltage value (generally between 70 and 100 V RMS)
- The ringing configuration (fig.1)

### 2.2. Different kinds of Slic :

There are two Slic families :

- The Slic without integrated ring generator
- The Slic with integrated ring generator

Figure 1 : Different ringing configurations

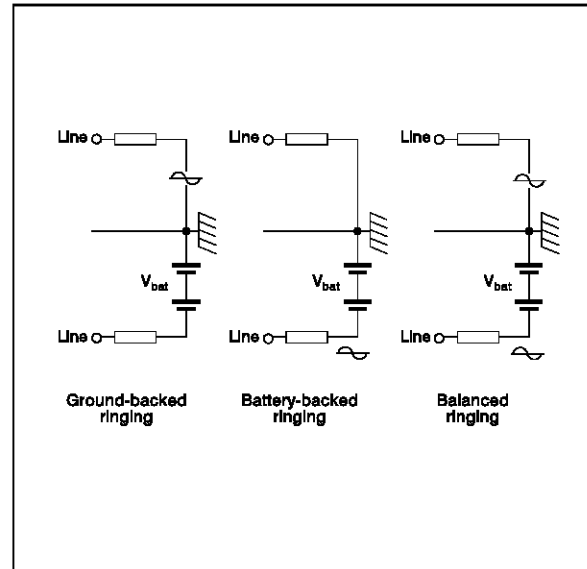
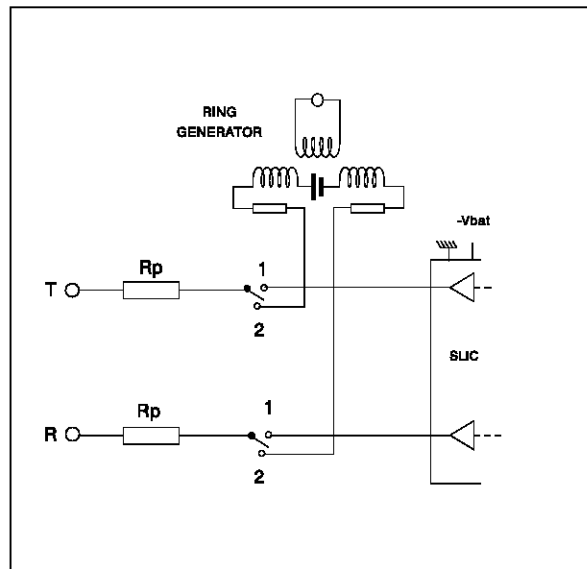


Figure 2a : Slic without integrated ring generator



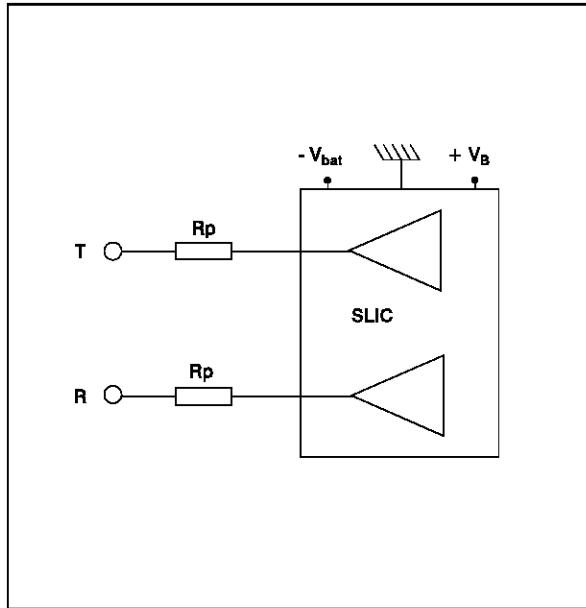
## APPLICATION NOTE

### 2.2.A/ Slic without integrated ring generator :

For this case the Slic IC is supplied between ground and the battery voltage ( $-V_{bat}$ ).

The relay operates the selection of functions, ringing mode in position 2 and the other modes in position 1. (see fig 2a).

**Figure 2b : Slic with integrated ring generator**



### 2.2.B/ Slic with integrated ring generator :

This kind of Slic, e.g. the L3000 family of SGS-THOMSON, is supplied between ground, the battery ( $-V_{bat}$ ) and a positive voltage ( $+V_B$ ) up to +72 V. (see fig 2b).

### 2.3. Goal of the Slic protection :

The purpose of the protection is to suppress all overvoltages out of the normal operating voltage range of the Slic.

We have to take into account the two kinds of Slic described in section 2.2.

### 2.2.A/ Slic without integrated ring generator :

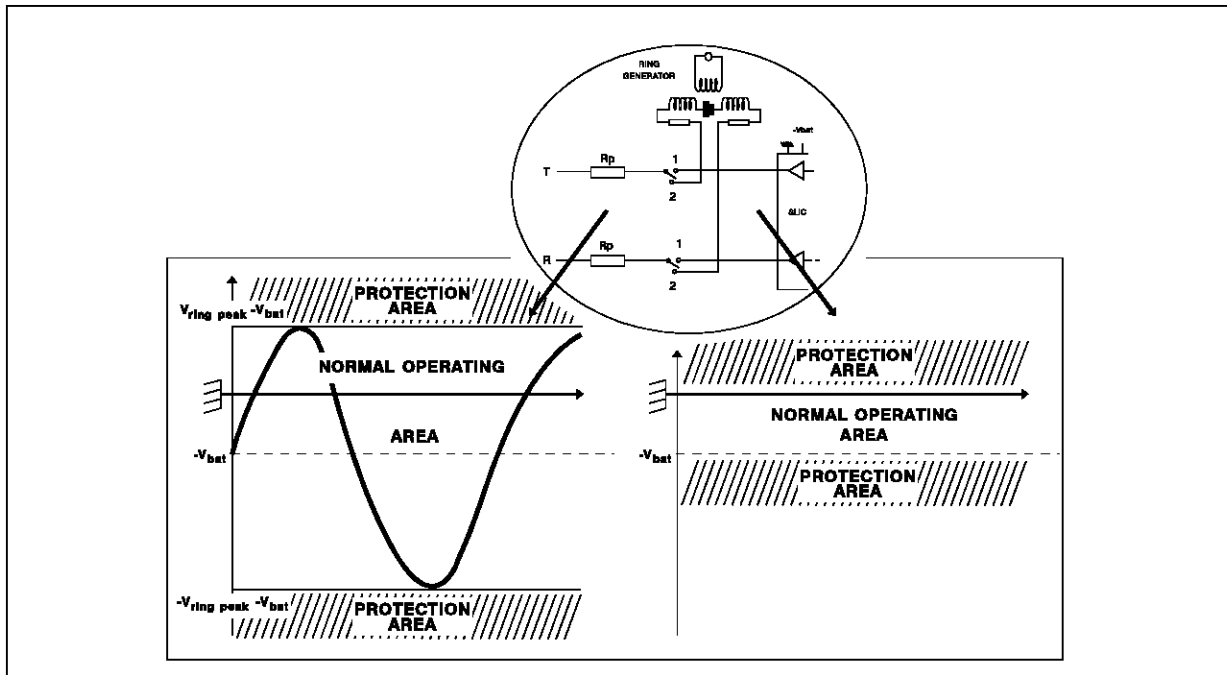
As shown in Fig.3, the protection areas are located differently before and after the ring relay.

Before the relay the protection must operate over the peak value of the ring signal (generally +90V and -190V). As the relay protection does not require a very precise clamping threshold, we usually use a symmetrical overvoltage suppressor (generally + or -200 V).

After the relay the protection acts to suppress all spikes above ground and below the battery voltage ( $-V_{bat}$ ).

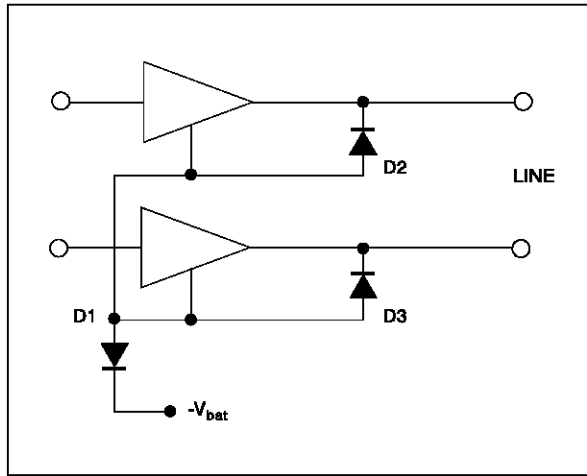
It is important to note that the integrated circuit needs a protection threshold as close as possible to the supply voltage.

**Figure 3 : Goal of the protection for the SLIC without integrated ring generator**



In certain cases an internal network of diodes allows the output stages of the Slic to be oversupplied (see fig.4).

Figure 4 : Internal diode network of the TDB7722

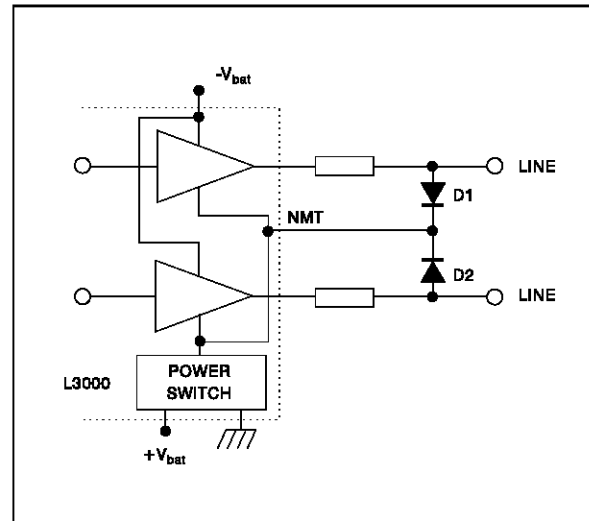


2.3.B/ Slic with integrated ring generator :

The integrated circuit L3000 of SGS-THOMSON is presently the only Slic of this kind. It operates between ground and the battery voltage for all the modes except for the ringing, where the operating area is located between  $+V_B$  (up to 72 V) and the battery voltage ( $-V_{Bat}$ ) (see Fig.5). The protection takes into account this fact and operates above  $+V_B$  and below  $-V_{Bat}$ .

The diodes D1 and D2 (fig.5) act when the L3000 operates out of the ringing mode and when a positive overvoltage is clamped at  $+V_B$ . The output stages are then temporarily oversupplied at  $+V_B$ .

Figure 5 : External diode network used with the L3000



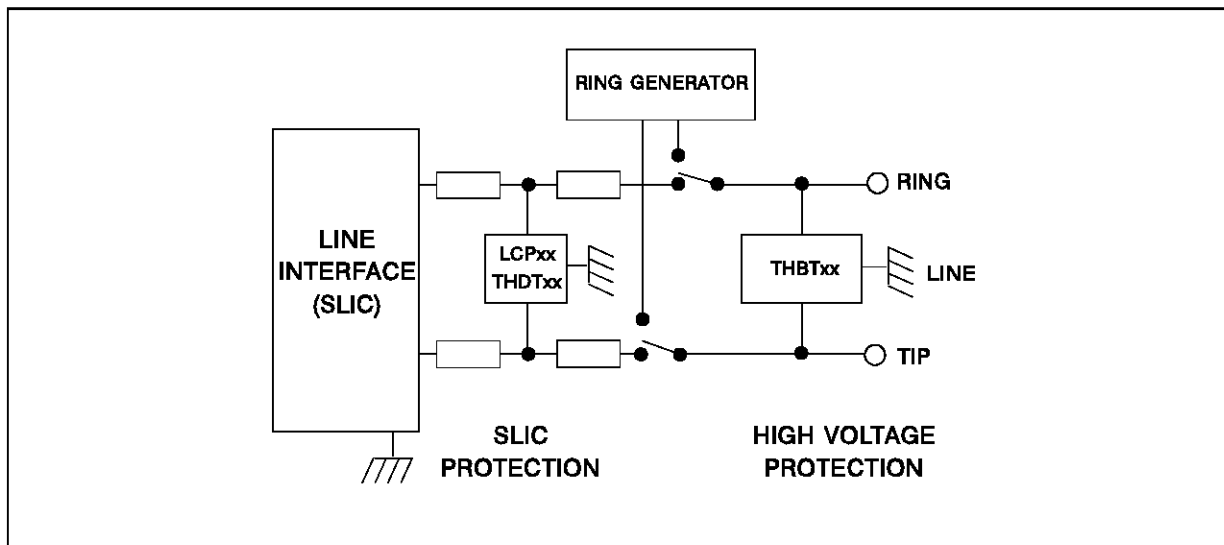
3. APPLICATION DIAGRAMS

3.1. Slic without integrated ring generator

Fig.6 below shows the protection topology for line card protection. The protection is divided into two stages :

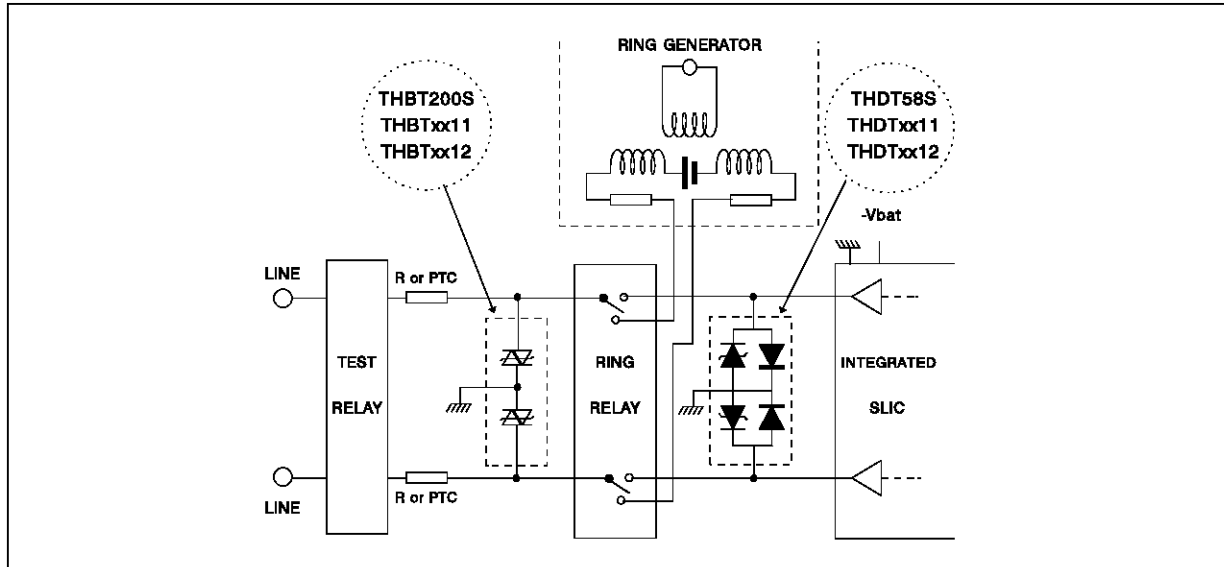
- The high voltage protection for ring relays (THBTxx series)
- The low voltage protection for the Slic. Here there are two possibilities :
  - Fixed breakdown voltage (THDTxx series).
  - Programmable breakdown voltage (LCPXX series)

Figure 6 : Typical line card protection at PC board level



3.1.1. Slic protection with fixed breakdown voltage.

Figure 7 : Line card protection kit



A specific product range for line card protection is available with kit solutions (for ring relays and Slic protection) in S08, DIL8 and SIP3 packages. As shown in figure 7, they are bidirectional functions for relay protection and asymmetrical functions for Slic protection.

These solutions provide the following advantages:

- Different surge current capabilities are available.
- Area used by the protection on the PC board is reduced.
- Optimum cost/performance compromise is possible.

Fig. 8 and fig.9 show the product range offered by SGS-THOMSON, with versions available also in axial form or in the surface mount package SOD15.

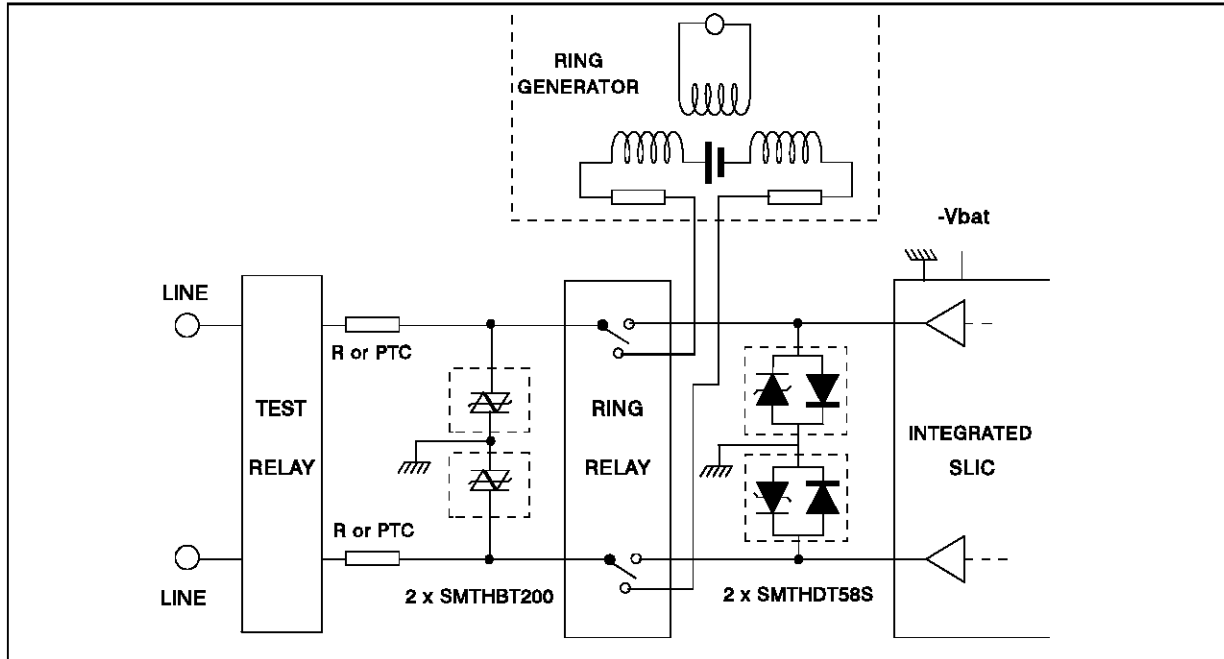
Figure 8 : High voltage protection range = THBTxx

TRISIL	DUAL TRISIL	3 TERMINAL TRISIL	
SOD15	SIP3	SO8	DIL8
75A @ 10/1000 μsec		30A @ 10/1000 μsec	
SMTHBT 200	THBT200S	THBT15011 THBT20011 THBT27011	THBT15012 THBT20012 THBT27012

Figure 9 : Slic protection range fixed breakdown voltage = THDTxx

SOD15	CB429	SIL3	SO8	DIL8
HIGH SURGE CAPABILITY 75A @ 10/1000μsec			MEDIUM SURGE CAPABILITY 30A @ 10/1000 μsec	
SINGLE FUNCTION		DUAL FUNCTION	DUAL FUNCTION	
SMTHBT58	TPU58	THDT58S	THBT5111 THBT6511	THBT5112 THBT6512

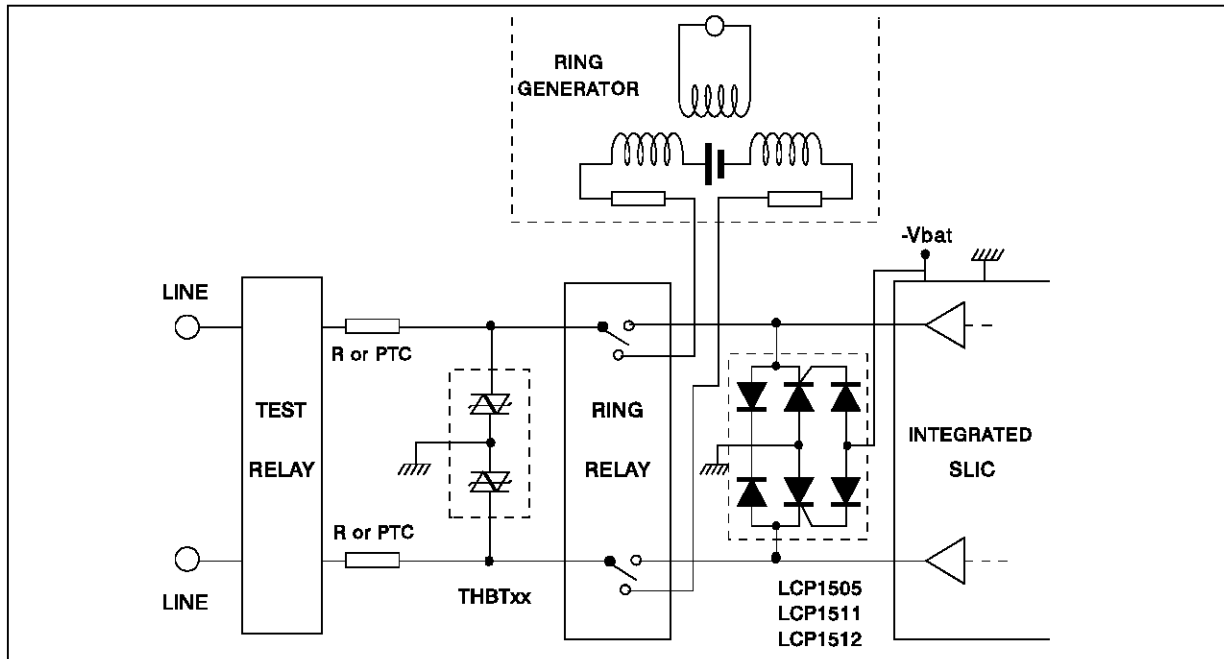
Figure 10 : Surface mount solution in SOD 15



This solution is mainly used to benefit from the high surge current capability of the SOD 15 package for AC tests. Such high surge performance can only be achieved with this SMD package.

### 3.1.2. Slc protection with programmable breakdown voltage

Figure 11 : Monochip programmable breakover voltage solution



With this solution, the protection performance is improved by the possibility of adjusting the breakdown voltage to the battery voltage. This function is well suited to variable battery voltage applications such as short / long line switching.

## APPLICATION NOTE

Figure 12 gives the product range with this function, available in SIL4, DIL8 and SO8 packages.

**Figure 12 : Slic protection range LCPxx - Programmable breakdown voltage**

SIL4	SO8	DIL8
<b>HIGH SURGE CAPABILITY</b> 75A @ 10/1000 $\mu$ sec	<b>MEDIUM SURGE CAPABILITY</b> 30A @ 10/1000 $\mu$ sec	
LCP150S	LCP1511	LCP1512

### 3.2. Slic with integrated ring generator : (Slic L3000)

Many types of Slic protection solutions exist, depending on :

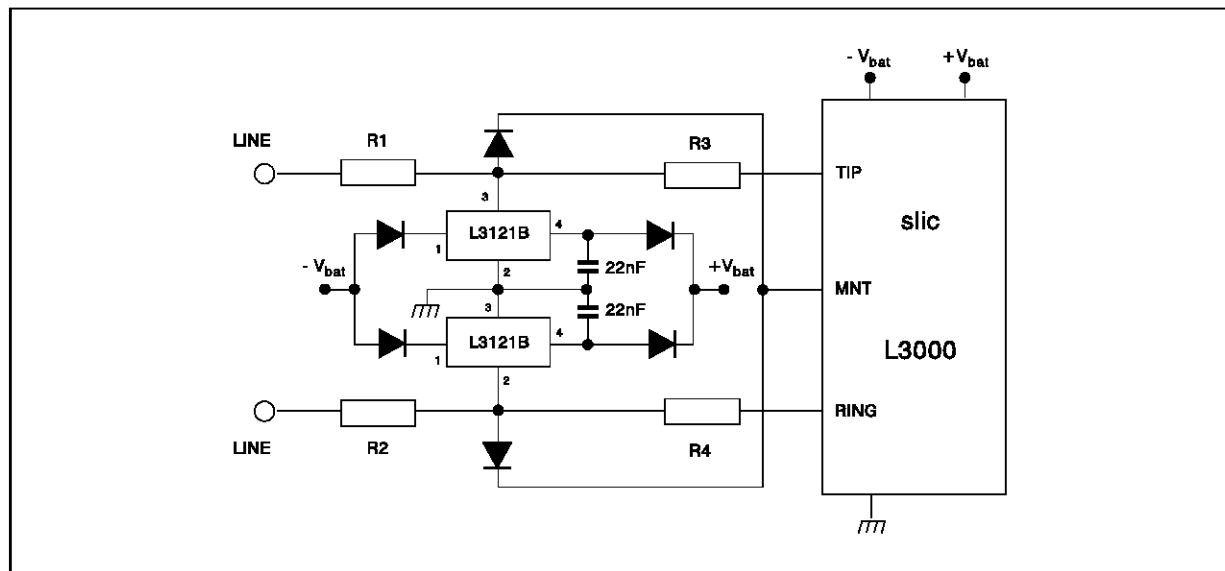
- The battery voltage
- The PC board area available for the protection
- The cost / performance compromise

#### 3.2.1. L3000 protection with 2 x L3121B

This topology (Fig.13) is the most efficient one for this kind of Slic.

#### 3.2.2. L3000 protection with 2 x L3100B

**Figure 13 : L3000 protection with 2 L3121B**



**Figure 14 : L3000 protection with 2 L3100B**

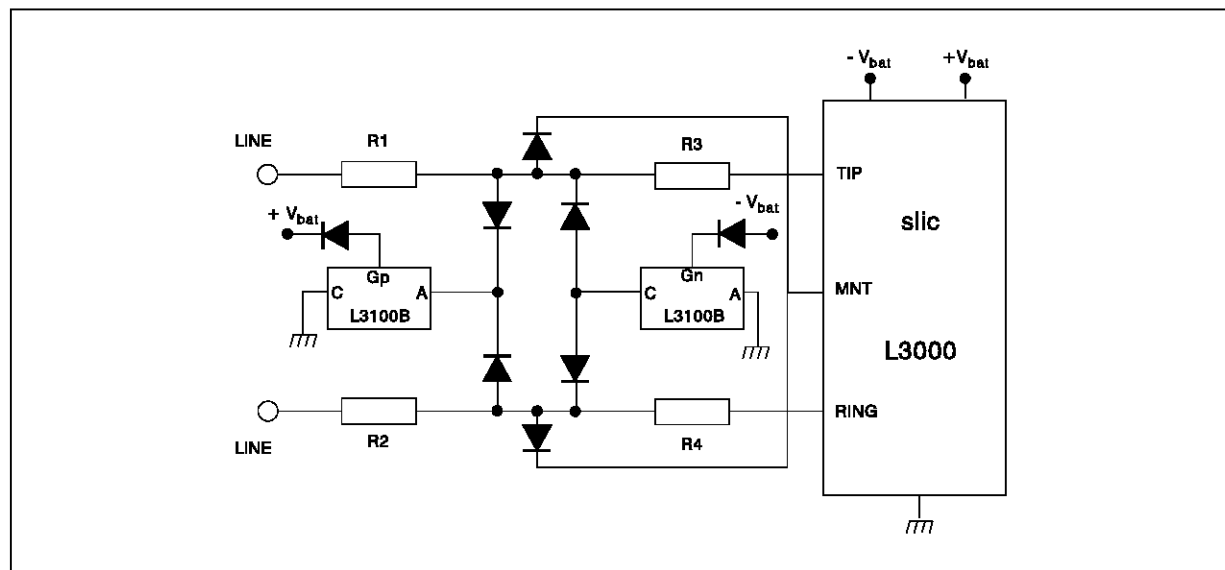


Figure 14 has the same electrical behaviour as the previous one but with lower cost.

**3.2.3. Multiline common protection :**

These types of application (Fig.15 and 16) decrease the cost of the protection per line. The major drawbacks of these solutions are :

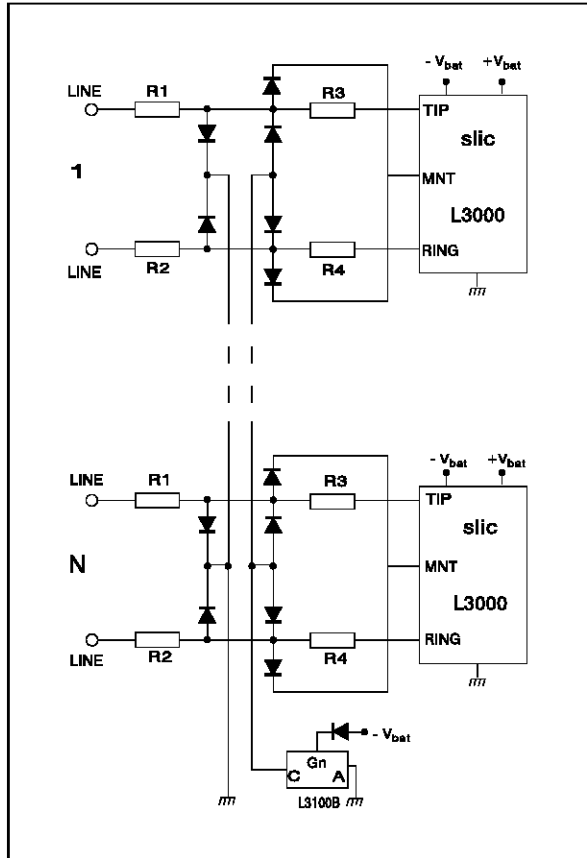
- The short circuit across all the lines when the protection device fires.
- The current remaining through the protection

device after the surge is too high to allow its automatic switch-off. This must then be effected by a software instruction, e.g. power-down.

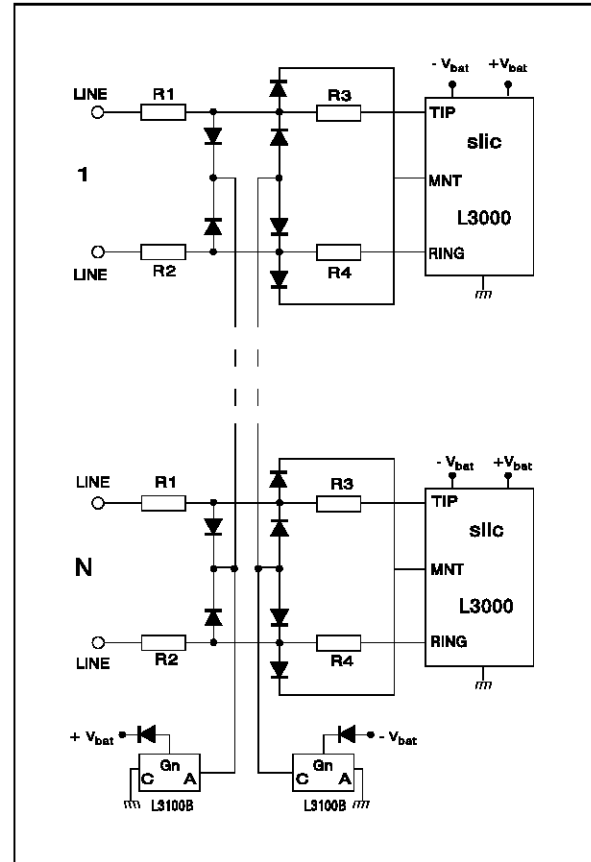
**4. CONCLUSION**

The wide range of protection devices on offer from SGS-THOMSON makes an optimized protection solution possible for every application.

**Figure 15 : Common protection for Slic without integrated ring generator**



**Figure 16 : Common protection for Slic with integrated ring generator**



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