

L3000N/L30XX SLICs PROTECTION CIRCUITS

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INTRODUCTION

In this application note are described different ways to protect L3000N/L30XX SLIC KITS.

The L3000N/L30XX are, COMPARED TO STANDARD SOLUTIONS, more complex to protect because the positive battery can be either GND or VB+ (typ. +72V) depending on the SLIC operating mode. In the following three protection solutions for the L3000N/L30XX KITS are described.

The first solution is based on programmable transient suppressor L3121; and this is the most complete one: another simpler solution, based on standard transient suppressor like LS5120 or TRISIL is proposed. Finally a way to use only one transient suppressor for more subscribers is described.

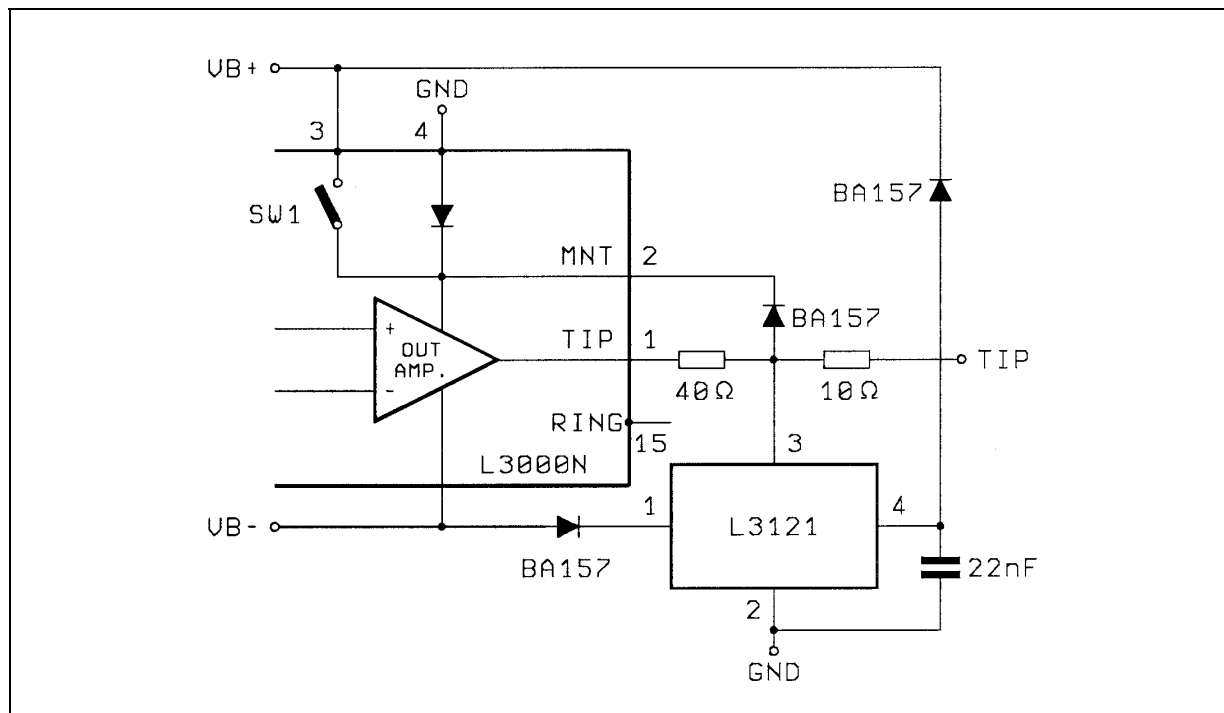
L3000N/L30XX PROTECTION CIRCUIT BASED ON PROGRAMMABLE TRAN-SIENT SUPPRESSOR L3121

In fig. 1 you can see the circuit configuration used

Figure 1: Protection Circuit for L3000N (half section)

to protect the L3000N/L30XX SLIC KITS with L3121. (The same structure is applied to the RING termination). When the voltage on the line increase above VB+ (typ +72V) or decrease below VB (typ. -48V) the transient suppressor L3121 intervenes and shorts the wire to ground.

For each wire we need one L3121 ; one 22nF capacitor to increase the intervention speed and three diodes : two to program the intervention voltage levels and one to pull up the supply voltage of the internal stages in order to avoid reverse voltage between line termination and supply voltage. In fact if you look at fig. 2.1. you can see that the internal output stage of the device can be fed either by GND or by VB+ depending on the status of the internal switch SW1. Since in normal operation the circuit is fed by GND and the protection intervenes when the line voltage exceeds VB+ it is evident that the reverse voltage between line termination and supply can damage the device. To avoid this fact a diode connected between line and supply increases the supply voltage when the line voltage increases (see fig.1).



APPLICATION NOTE

L3000N/L30XX PROTECTION CIRCUIT BASED ON STANDARD TRANSIENT SUPPRESSOR AS L5120 OR TRISIL.

In this paragraph is described a cheaper solution (respect to the one described in par. 2) to protect L3000N/L30XX SLIC KITs.

The protection circuit is based on two LS5120 or equivalent TRISIL, a polarity guard and two diodes to avoid reverse voltages between line termination and internal stages supply (see par. 2). The two external 50ohm resistors are splitted in three parts.

See the circuit of fig. 2.

If a surge is induced on the line the LS5120 intervenes and within 100ns it clamps the surge. During the first 100ns the LS5120 works like a 180V Zener Diode. The polarity guard avoid this 180V pulse to reach SLIC line terminations shorting it to the supply voltage (see fig. 3.1.).

Two capacitors C1 and C2 guarantee that in presence of negative or positive surges the supply voltage remain constant enough. These capacitors can be easily dimensioned considering that the 100ns current peak flowing through the polarity guard is equal to about $110V/10\Omega = 11A$ in the

case of positive surges and about $130V/10\Omega = 13A$ in the case of negative ones.

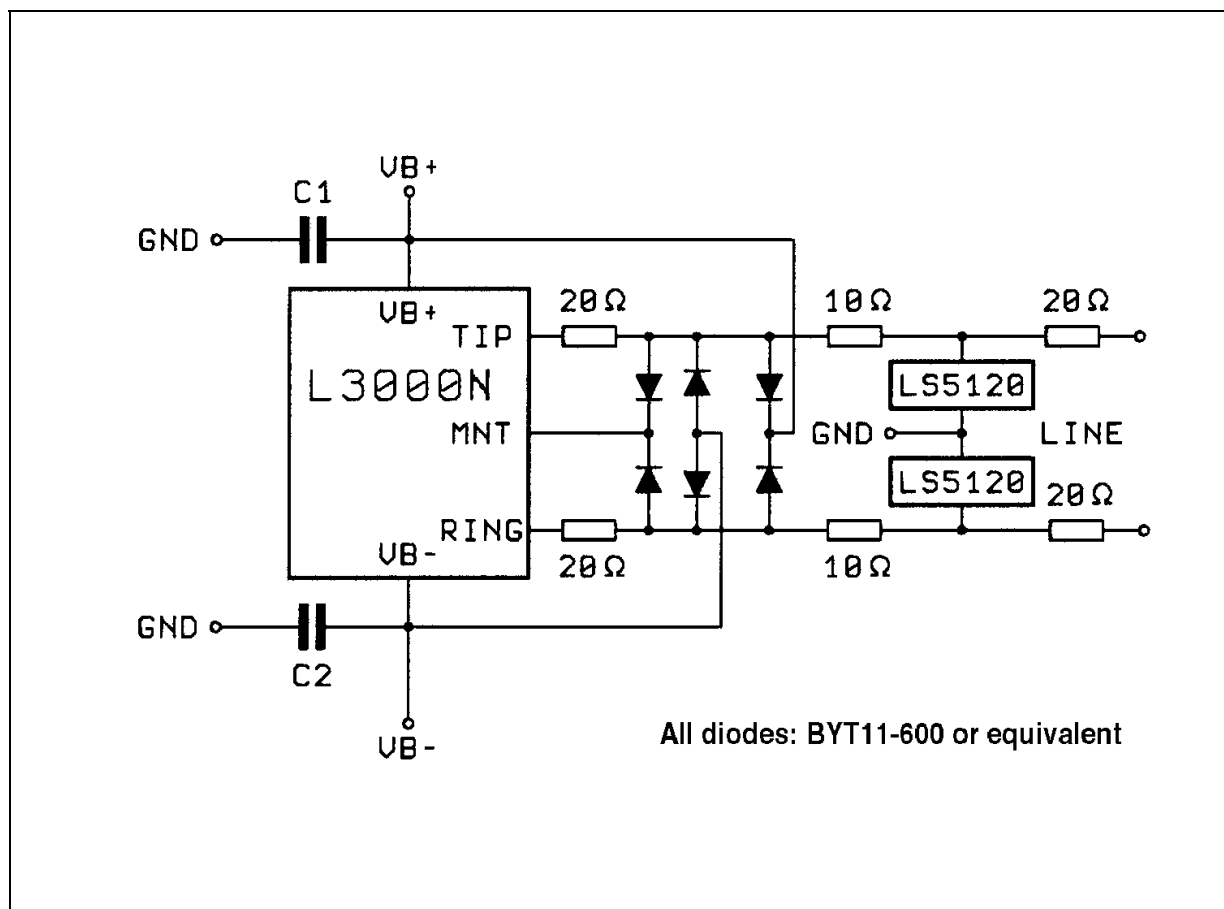
For negative surges (worst case) the charge Q injected in the capacitor is $13A \times 100ns = 1.3\mu C$ (supposing that no current flows through the power supply) therefore a $1\mu F$ capacitor is large enough to guarantee a less than 1.5V supply variation.

If instead of LS5120 another similar device like Trisil is used the capacitors C1 and C2 have to be dimensioned depending on the clamping time of such device.

It should be noted that the diode type used in the polarity guard is important in order to guarantee good performances. The suggested diodes for this application are BYT11-600 or equivalent. We observe that this kind of diodes in presence of a 10A, 200ns current pulse show a voltage drop of about 3V, while diodes as 1N4004 in presence of the same pulse shows a voltage drop ten times larger (30V).

It should be noted that in presence of power cross the V_{B+} supply should be able to sink current and the V_{B-} to source current.

Figure 2: L3000 Surge Protection Circuit Based on LS5120.



L3000N/L30XX COMMON PROTECTION CIRCUIT FOR MORE SUBSCRIBERS BASED ON PROGRAMMABLE TRANSIENT SUPPRESSOR L3100.

In this solution each SLIC is protected by means of a polarity guard that, in case of a surge, avoid the line terminations to exceed the supply voltages. In the following page you can see the circuit schematic of this solution.

Consider that in this application the current peak flowing through the polarity guard can reach 100A for 3KV surges ; therefore proper diodes must be used in order to avoid excessive voltage drop in presence of such current peak.

When a positive (negative) surge occurs on one line the common protection P1 (P2) clamps all the lines to ground.

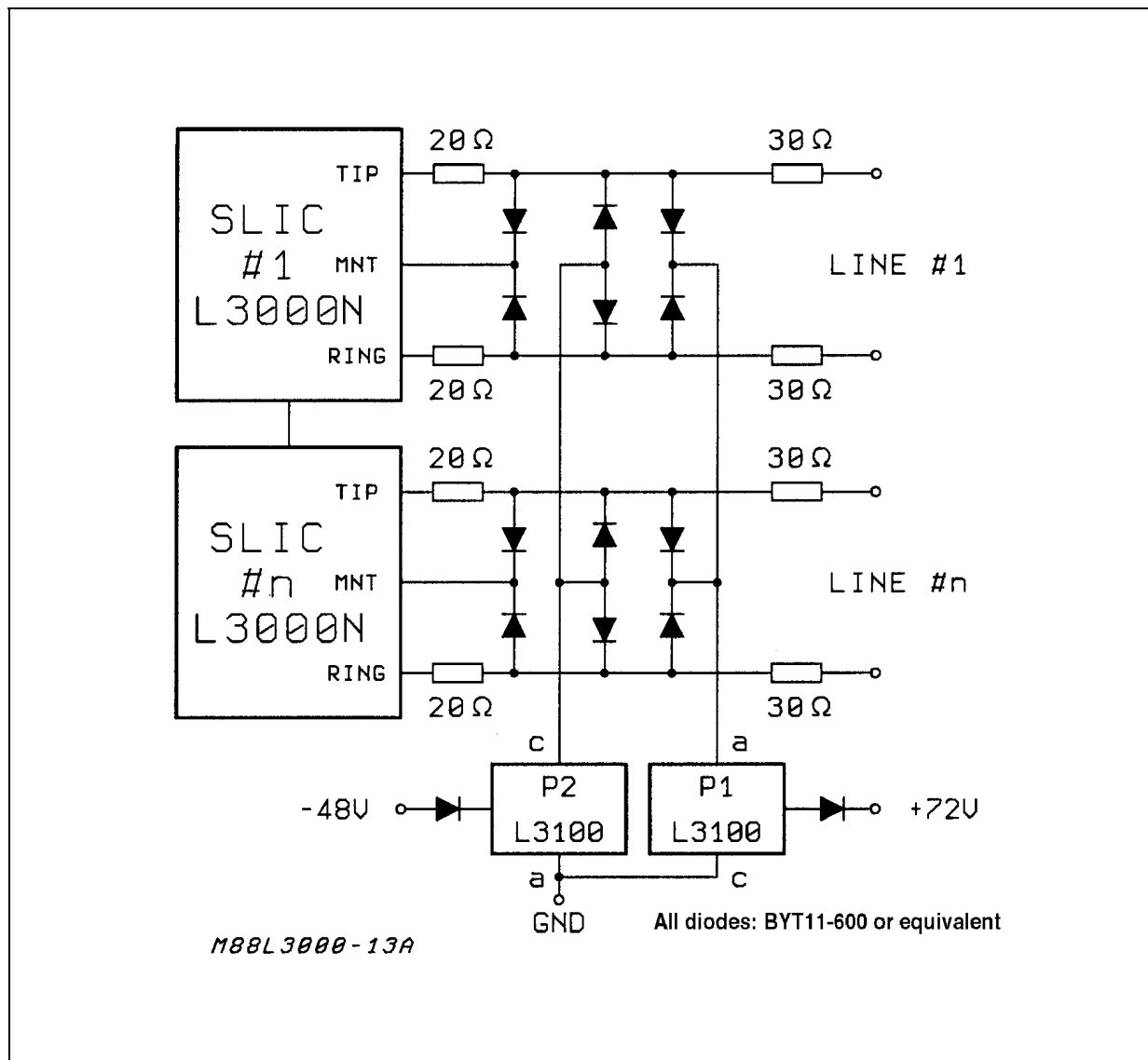
Since when you short a line termination to ground the SLIC can source or sink (depending on the line termination status) up to 100mA, it can happens that once finished the surge the protection remain clamped because of the line currents.

If this fact happens all the SLICs connected to the same protection detect ground key, in this way the controller can recognize that one protection is clamped.

One possible way to open clamped protection (once the surge is finished) is to set all the SLICs connected to it in power down mode for a short time. In this way for a moment no current flow through protection allowing it to open.

Finally the protection intervention time can be further improved connecting one 6.8nF/100V capacitor between pin 1 and pin 3 of each L3100.

Figure 3: L3000 Common Protection Circuit.



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