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ESD Protection for the SGL-0622Z GPS LNA

RFMD Worldwide Applications

Description

The SGL-0622Z is a low power, high gain, fully matched LNA designed and optimized for GPS applications. The LNA was designed for low power 2.7V to 3.6V battery operation. The SGL-0622Z has internal ESD circuitry that provides Class 1C (HBM) protection (>1000V). The ESD performance of the LNA can be improved to at least 4000V (HBM) by implementing the circuit described below (see Figure 1). A single BAV99 diode has typical capacitance of 0.6pF, therefore both diodes in parallel have a capacitance of 1.2pF (reverse voltage=0V). The shunt BAV99 diodes and wire-wound inductor (Coilcraft, 0603CS) comprise a parallel resonant circuit at the operating frequency. There is minimal impact on RF performance, but the added circuitry greatly enhances the ESD robustness of the circuit. Operationally speaking, the inductor conducts most of the ESD charge to ground, while the diodes conduct the remainder. The inductor value noted below is optimized for 1575 MHz. Inductances for other frequencies can be calculated using the resonance formula and the known diode capacitance of 1.2 pF.

$L = 1/C*(2\pi F)^2$

The Q of the ESD circuit is relatively low, therefore applications requiring a wider bandwidth will still perform well. The RF performance over the complete band with the ESD circuit installed should be verified.

An additional benefit of this circuit is its high pass filter effect. With the ESD circuit added, the gain of SGL-0622Z rolls off below 800MHz (see Figure 2). The performance of the application circuit without the ESD circuit yields optimum gain down to at least 75MHz. Without the high pass filter, the VHF/UHF gain may be too high for certain applications. The filter effect of the ESD circuit could prove helpful for applications requiring less gain below 800MHz.

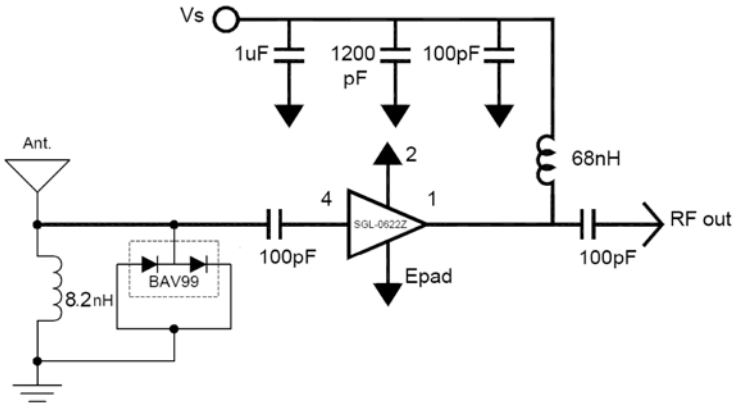

Figure 1. Application Schematic with ESD Circuit

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Test Data Summary

No ESD Circuit (3.0V, 1575MHz)

	S11	S21	S12	S22	NF	I_{CC}
Sample 1	-16.9	26.7	-36.5	-13.1	1.5	8.5mA
Sample 2	-16.6	26.7	-36.2	-13.1	1.5	8.5mA

ESD Circuit Installed (3.0V, 1575MHz)

	S11	S21	S12	S22	NF	I_{CC}
Sample 1	-13.8	26.5	-36.2	-14.1	1.5	8.4mA
Sample 2	-13.0	26.5	-36.5	-14.1	1.8	8.6mA

As seen above, critical RF parameters and operating current were unchanged after one positive 4kV and one negative 4kV ESD exposure (contact discharge).

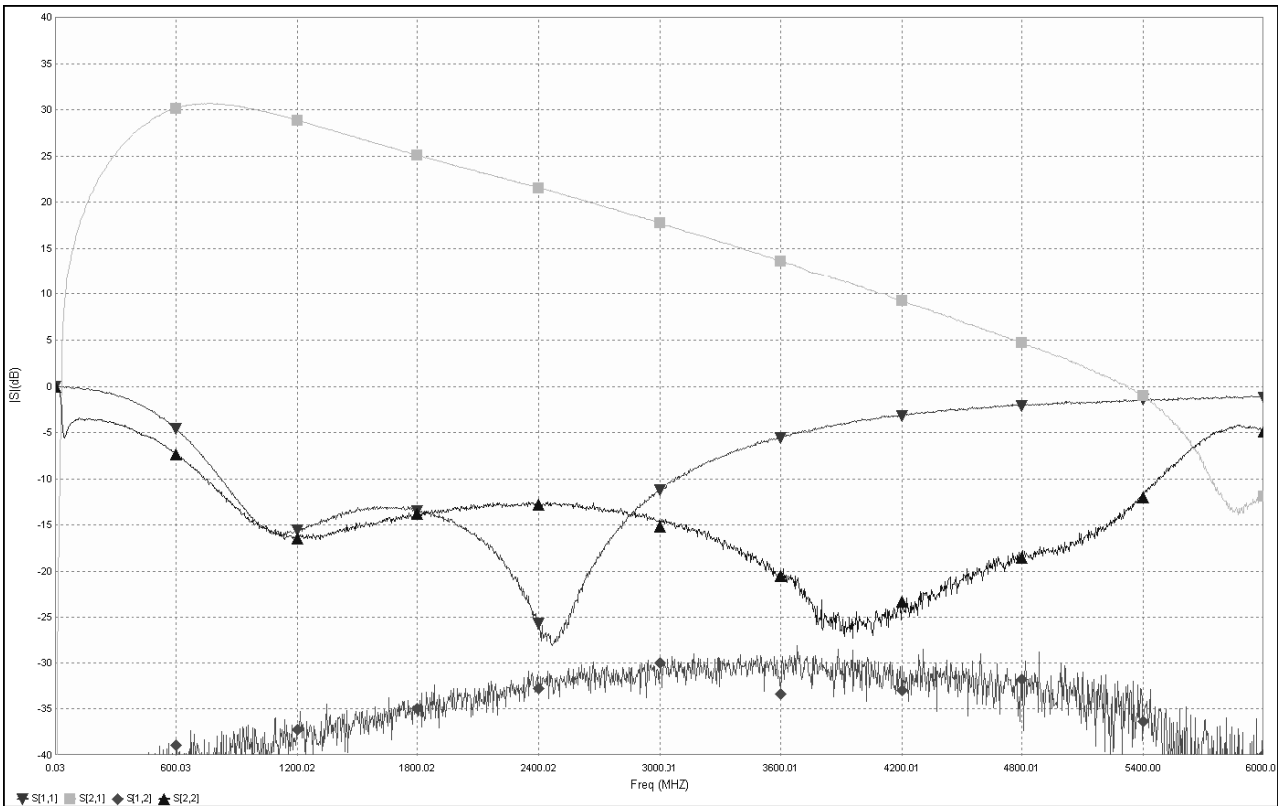

Figure 2. S-Parameters after +4000V and -4000V ESD Event

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