

Behavioral Analysis of Different Parallel Configurations of GaN Transistors for Low-Voltage, High-Current Applications

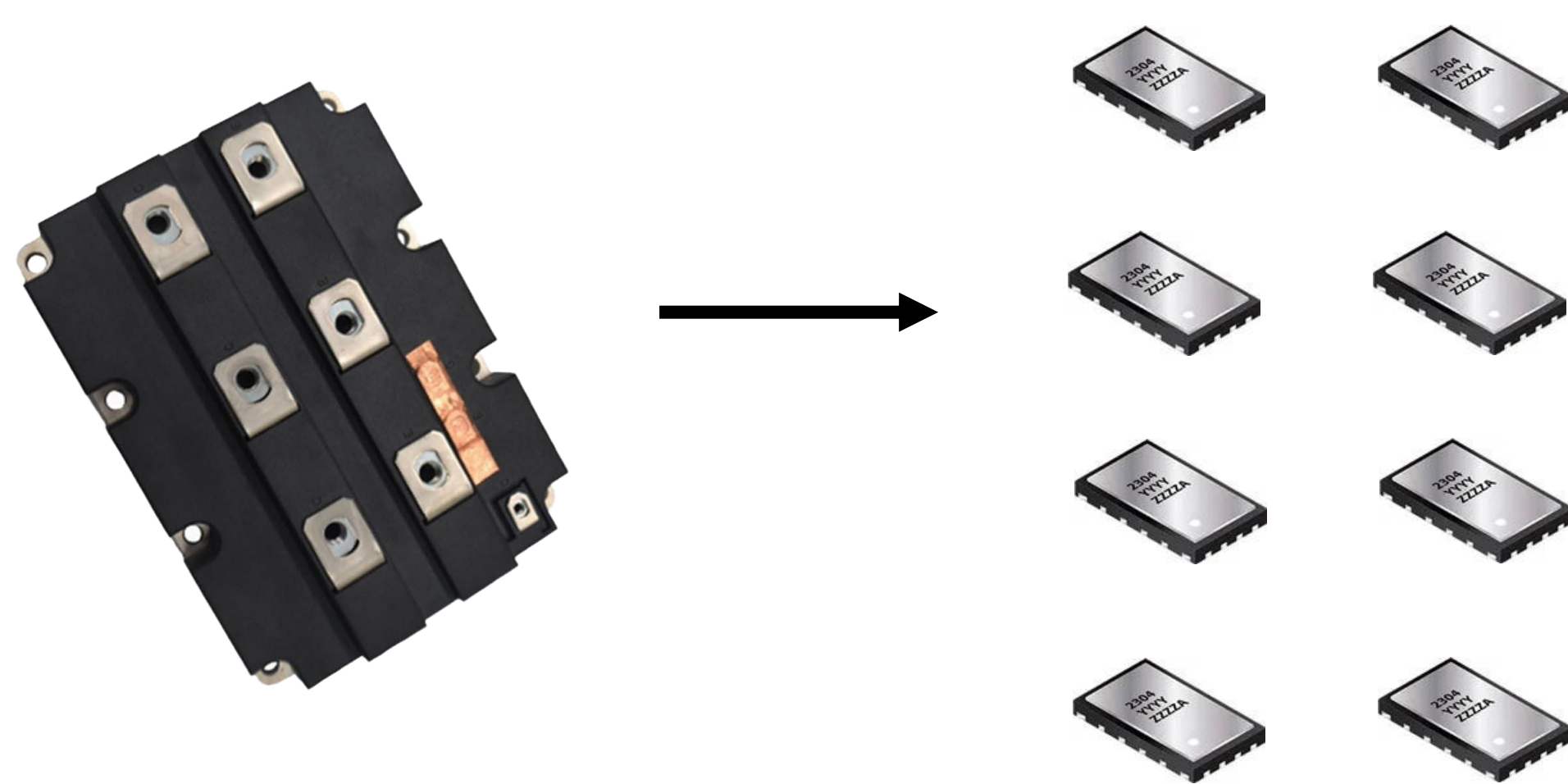
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XV JORNADA DE JÓVENES INVESTIGADORES/AS DEL I3A

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1. Introduction

Direct paralleling of GaN transistors offers greater flexibility compared to commercial modules, allowing the number of devices, layout, and thermal dissipation to be adapted to the specific requirements of the system. The parallelization of GaN is supported by the positive temperature coefficient of the $R_{DS, ON}$ of GaN HEMTs, which acts as a natural self-balancing thermal mechanism between parallel devices [1].

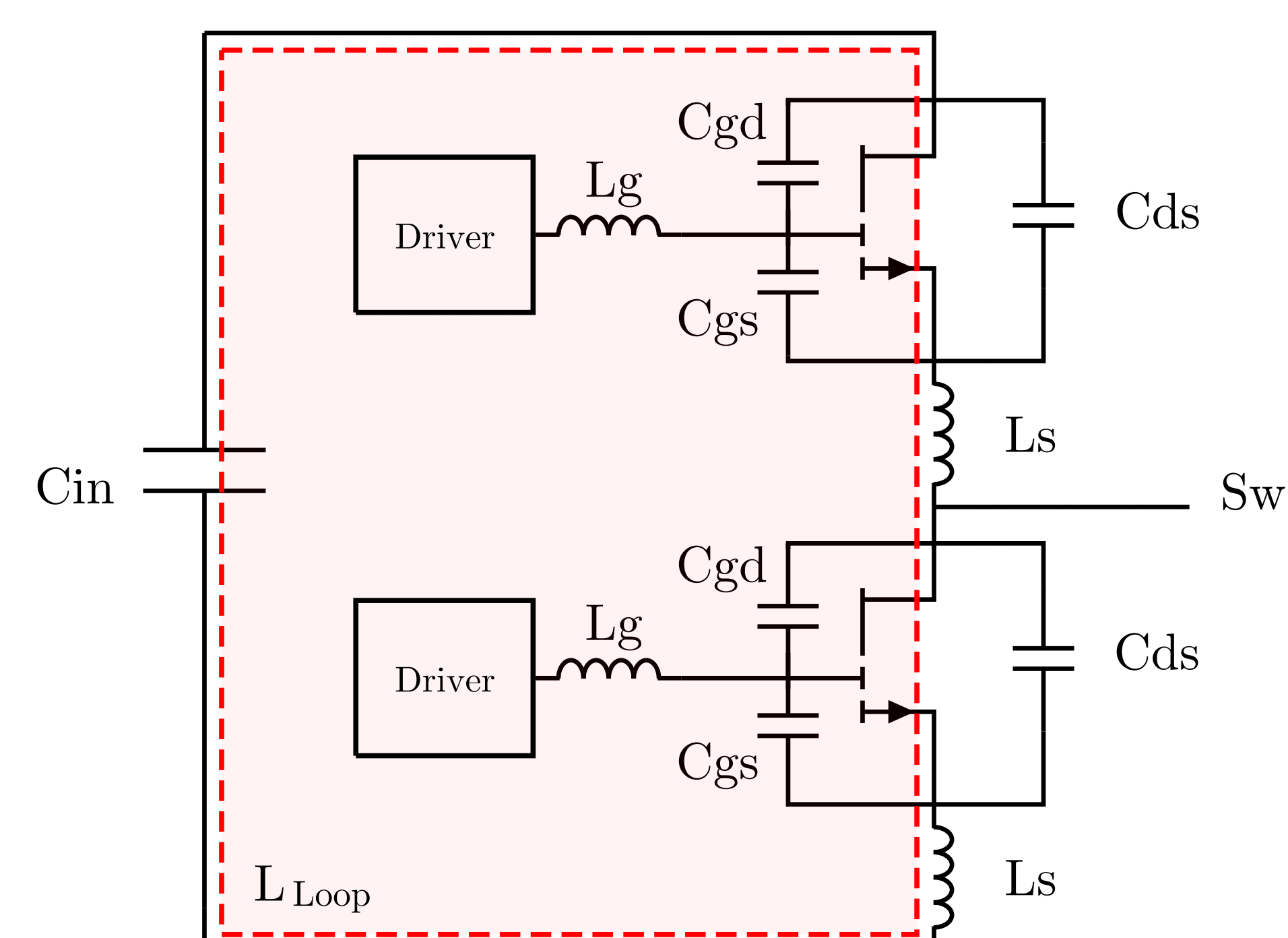


2. Design Methodology

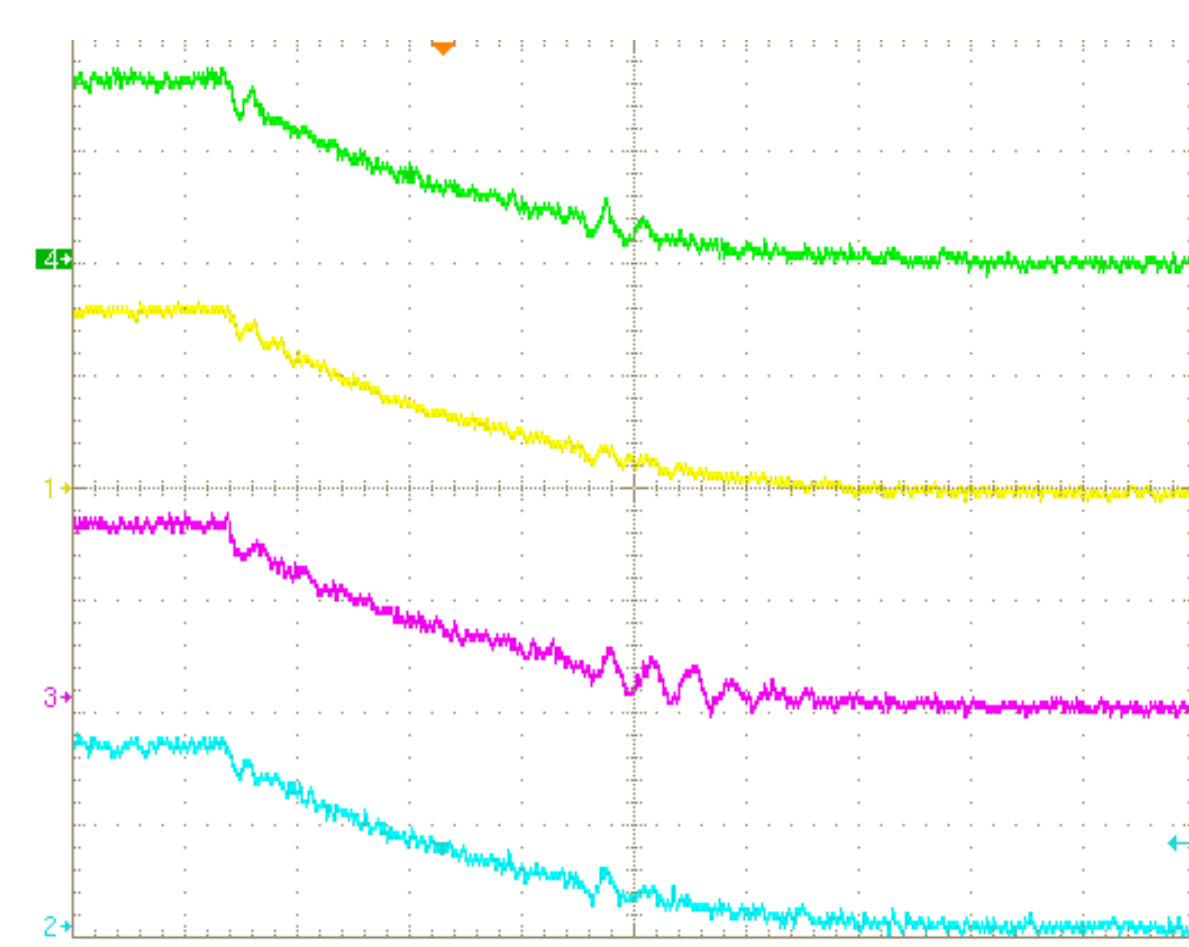
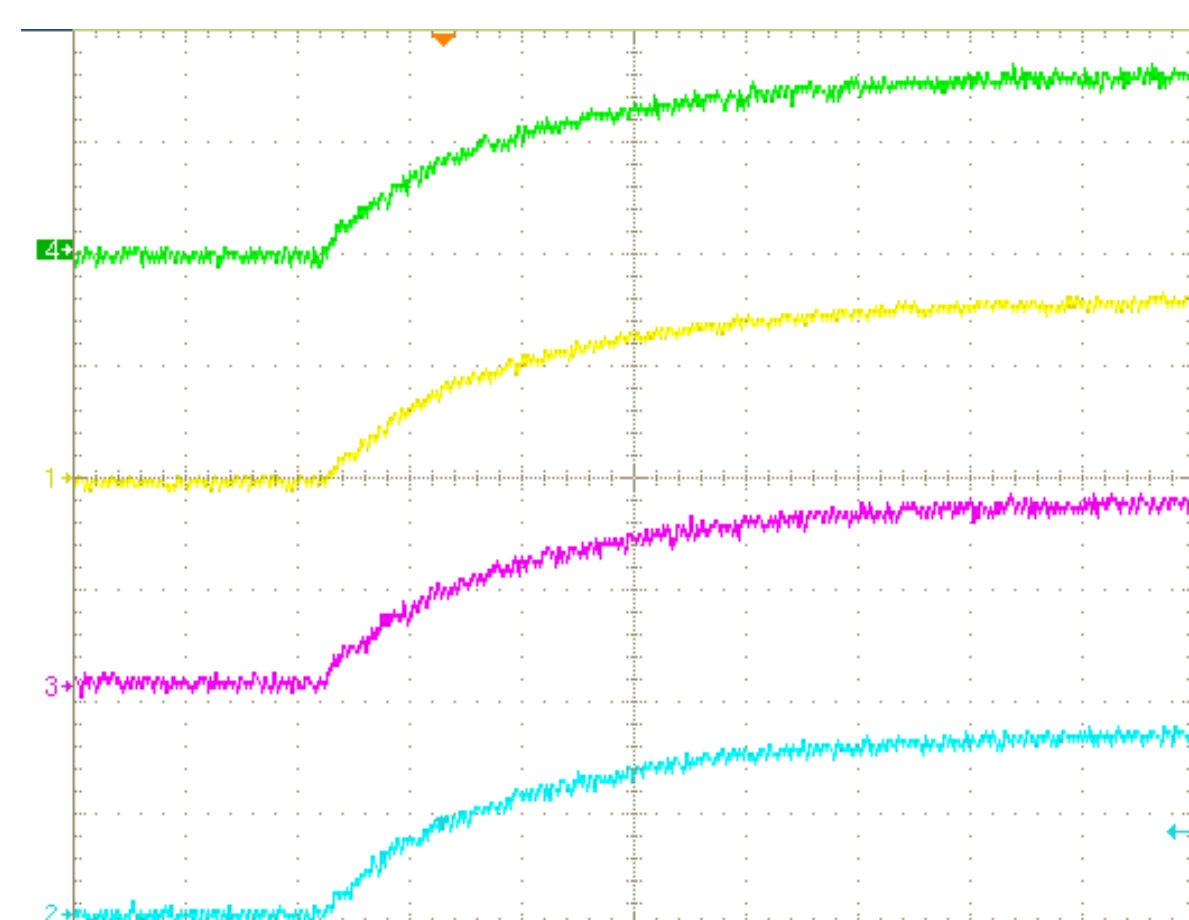
The layout must minimize:

- L_{Loop} , using current return paths in a multilayer PCB.
- L_S , using a Kelvin Source connection.

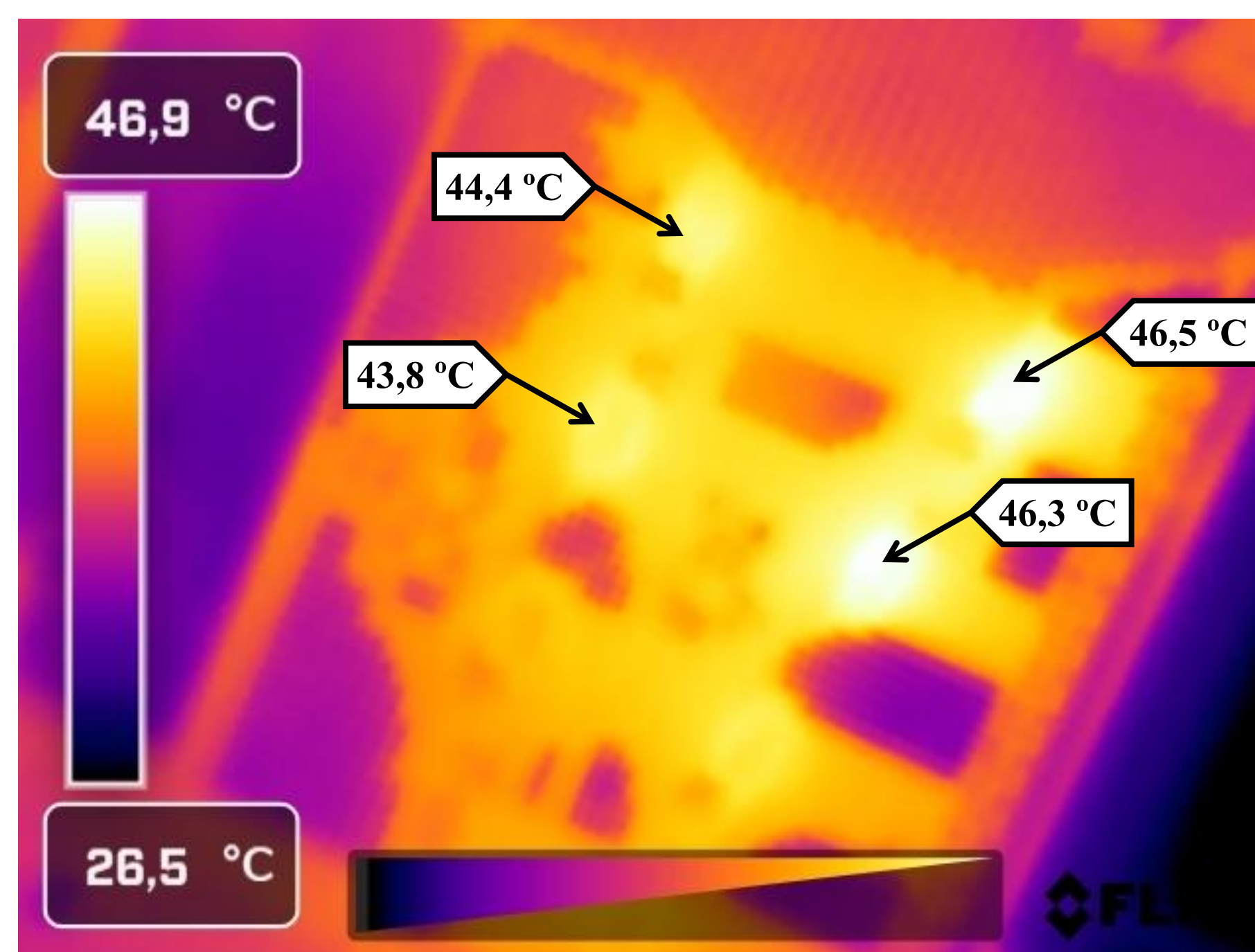
Furthermore, ensuring symmetry between branches is essential; asymmetry leads to uneven current distribution and thermal degradation [2]. High dv/dt and di/dt also introduce the risk of spurious turn-on and breakdown due to the parasitic effects of both the transistor and the gate drive circuit.



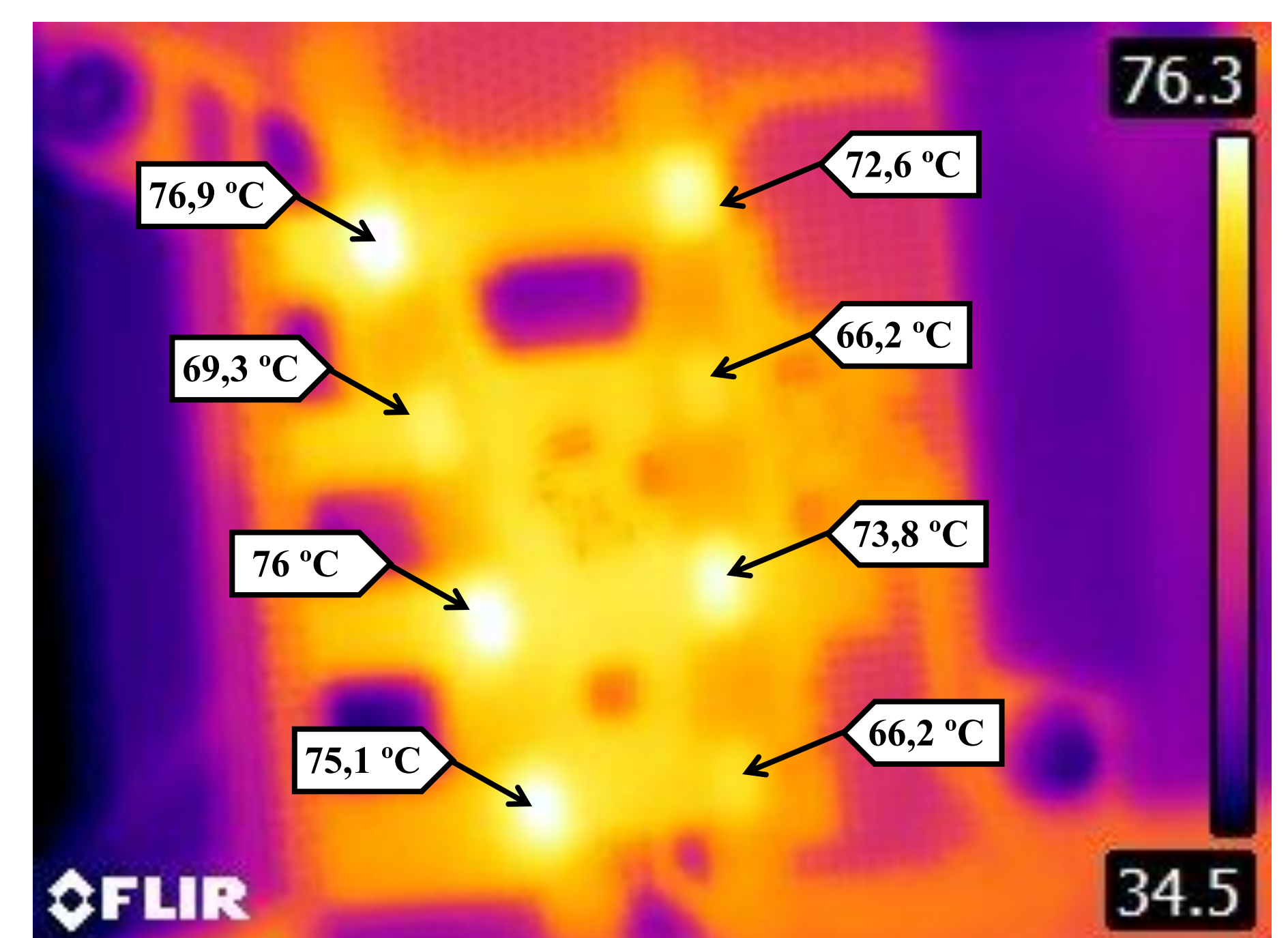
3. Experimental Results



High-side and low-side gate signals of 4 paralleled transistors during turn-on under a 30V and 40A load.



Thermal image of a half-bridge with 2 paralleled GaN transistors on the high side and low side under a 60V and 23A load.



Thermal image of a half-bridge with 4 paralleled GaN transistors on the high side and low side under a 60V and 60A load.

4. Conclusions

Efficient paralleling of GaN transistors requires the symmetry of the parasitic inductances L_{Loop} and L_S as a fundamental condition to guarantee current sharing.

The positive temperature coefficient of the $R_{DS, ON}$ provides an intrinsic thermal self-balancing that contributes to the stability of the assembly. Nevertheless, the high switching gradients demand special attention to EMI control.

5. References

- [1] M. Zhang y W. Zhang, "Current Sharing Analysis of Paralleled GaN HEMT Via Feedback Theory," Beijing Institute of Technology / North China University of Technology, pp. 94–99.
- [2] D. Reusch y J. Strydom, "Effectively Paralleling Gallium Nitride Transistors for High Current and High Frequency Applications," Applied Power Electronics Conference and Exposition (APEC), pp. 745–751, 2015.