



Laser Tests on a Power Operational Amplifier

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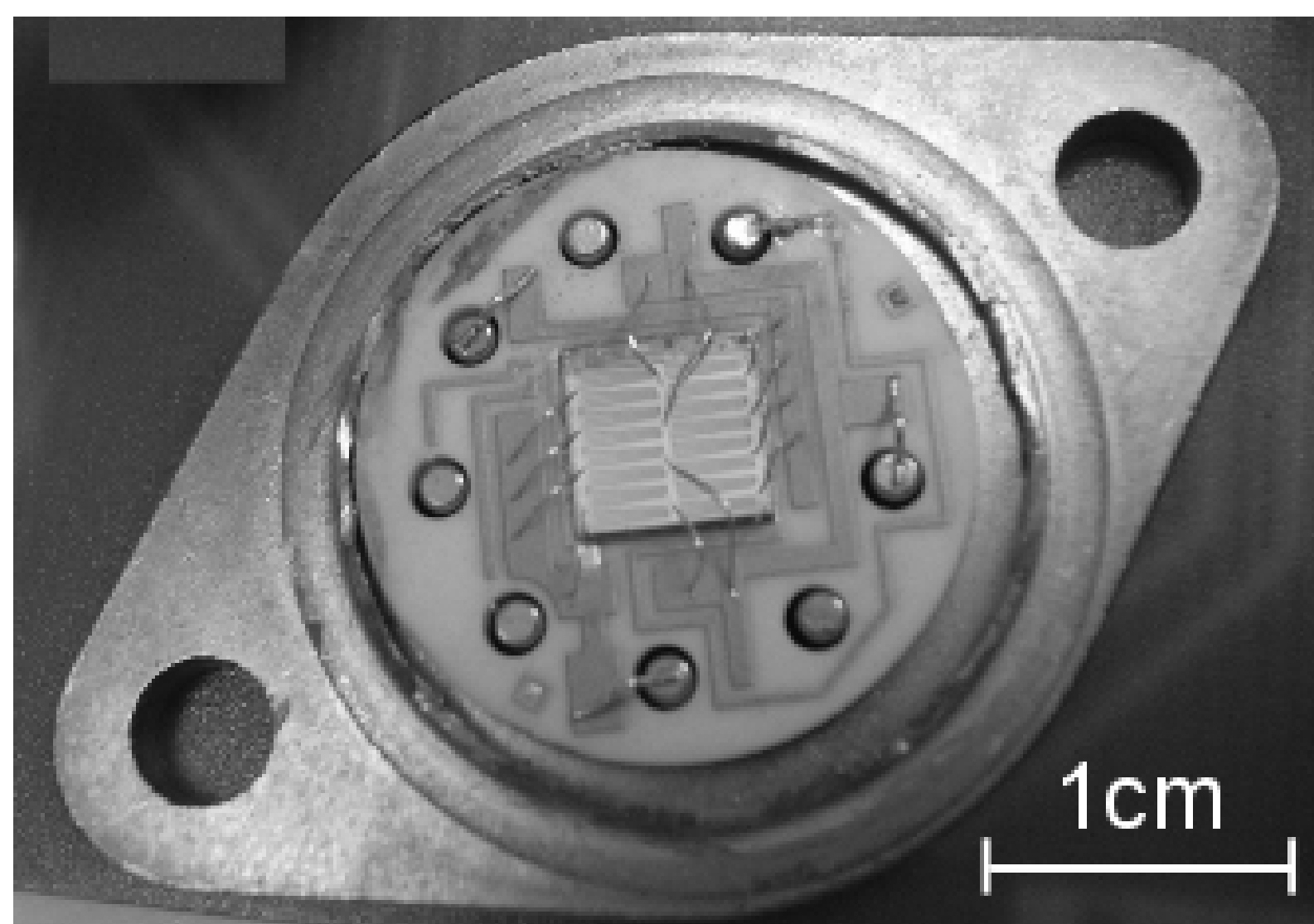


Abstract

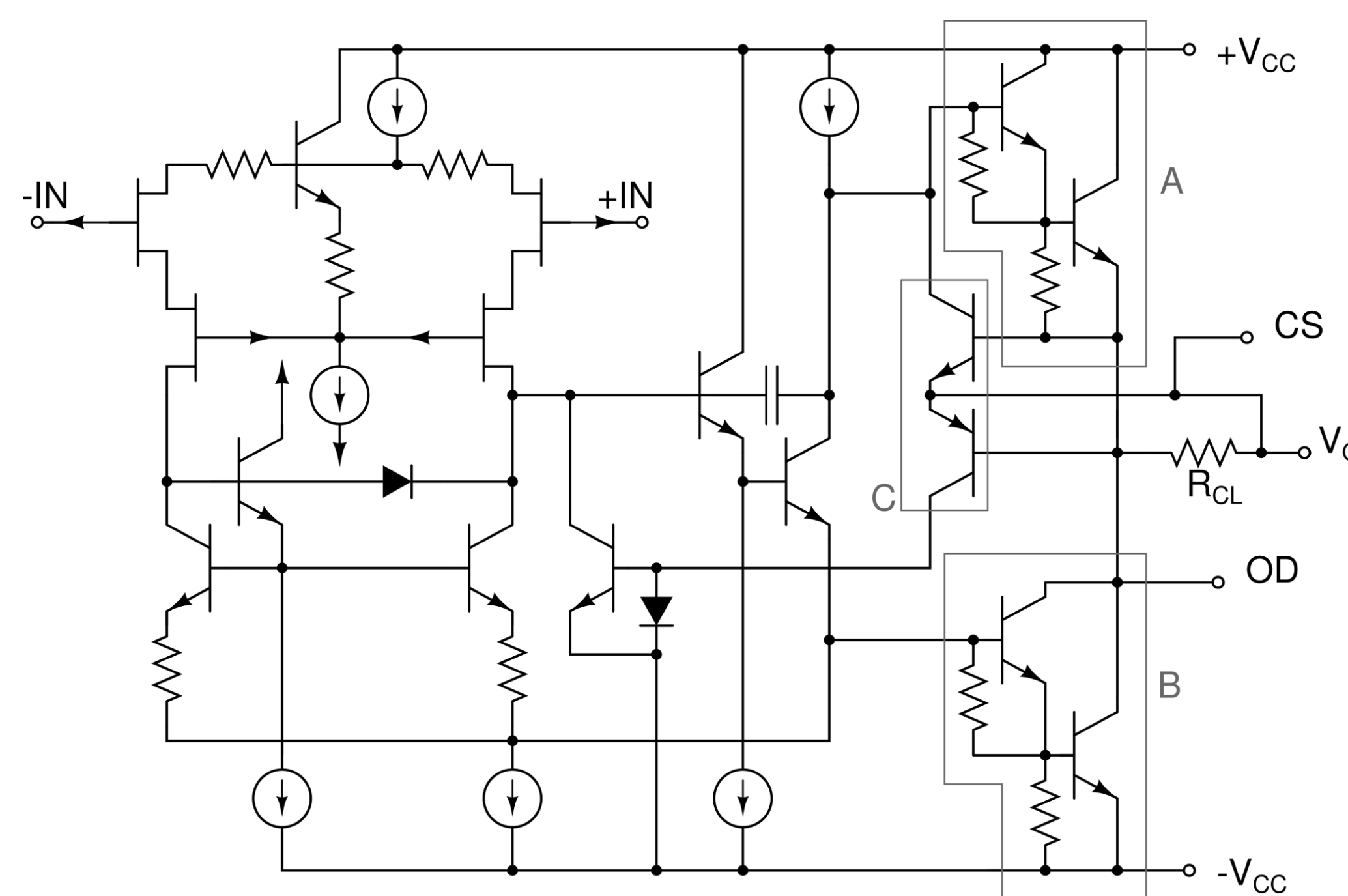
Laser tests on a power operational amplifier (OPA541) were performed to investigate its sensitivity to single event transients. These tests apparently point out to this device being quite insensitive to single event transients so it would become a good candidate to develop power systems to be used in radiation environments. OPA541 has been used in the LHC cryogenic system due to its insensitivity to TID and displacement damage.

Description of the device

A. Internal structure



The OPA541 once the top is removed. The package is typical metallic power TO-3.

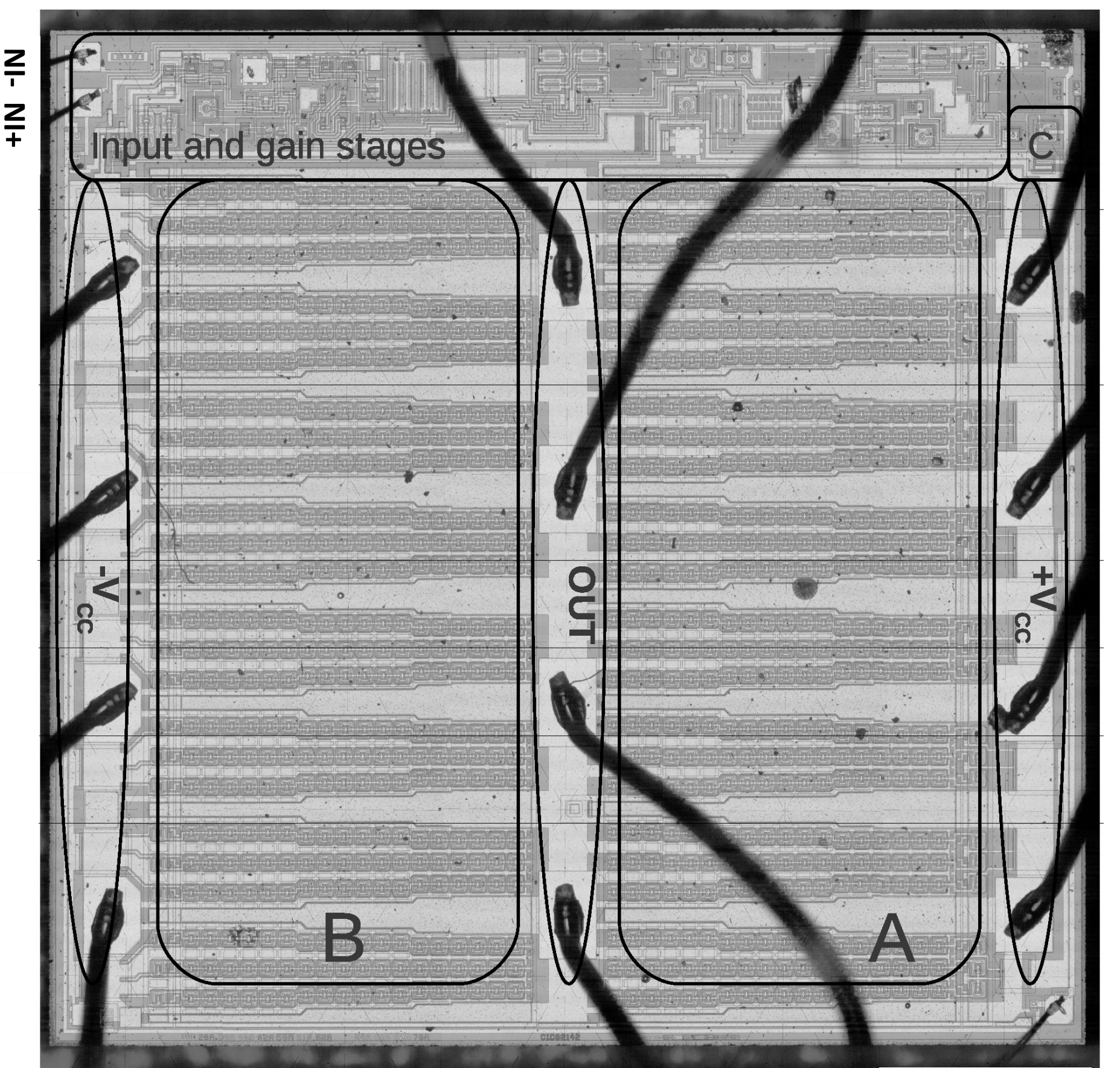


Schematic of the OPA541

CS – Current Sense

OD – Output

A and B – Arrays of vertical NPN transistors.



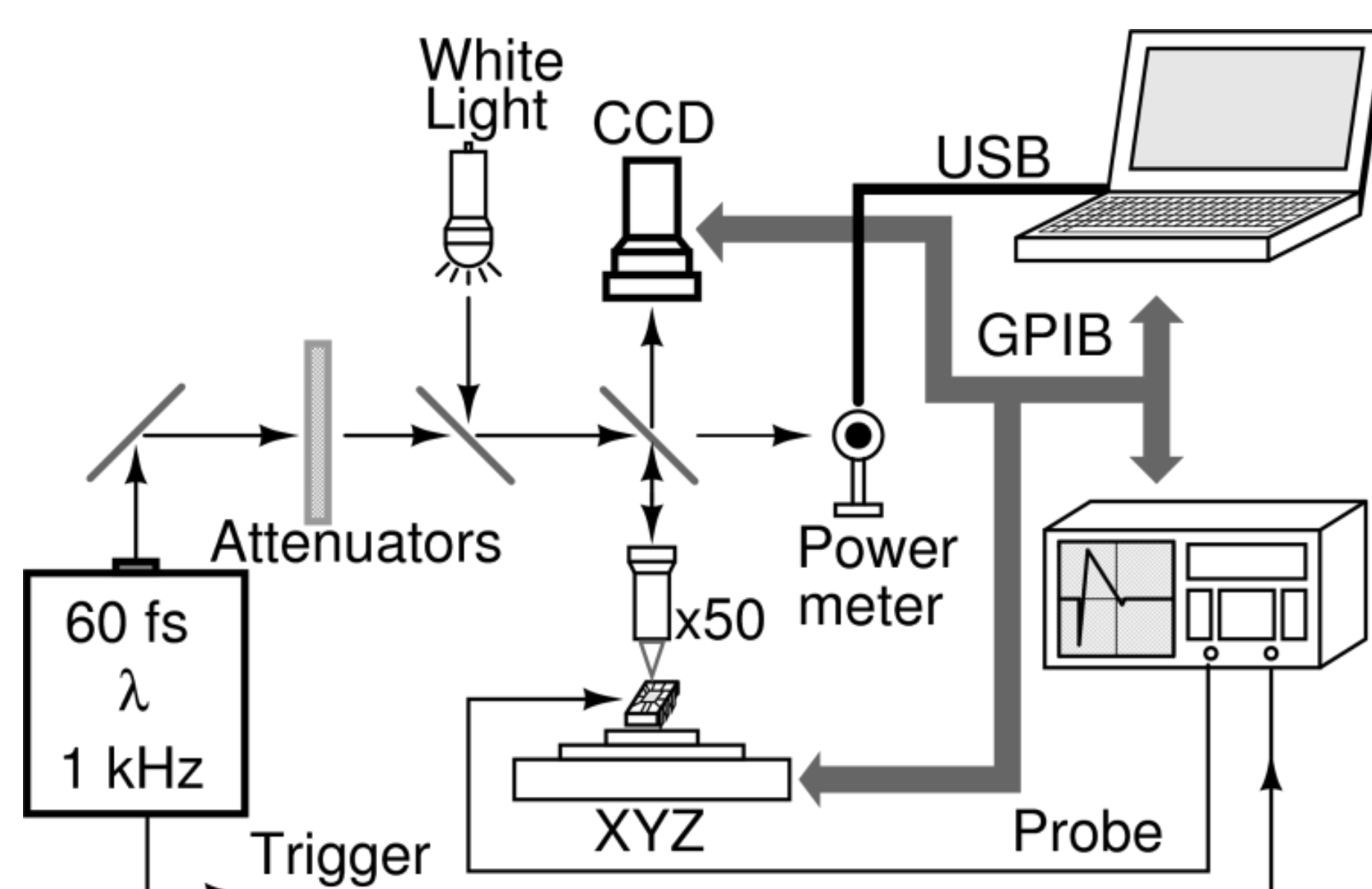
Current Sense

Layout of the operational amplifier. The size is 5335 μm x 5160 μm .

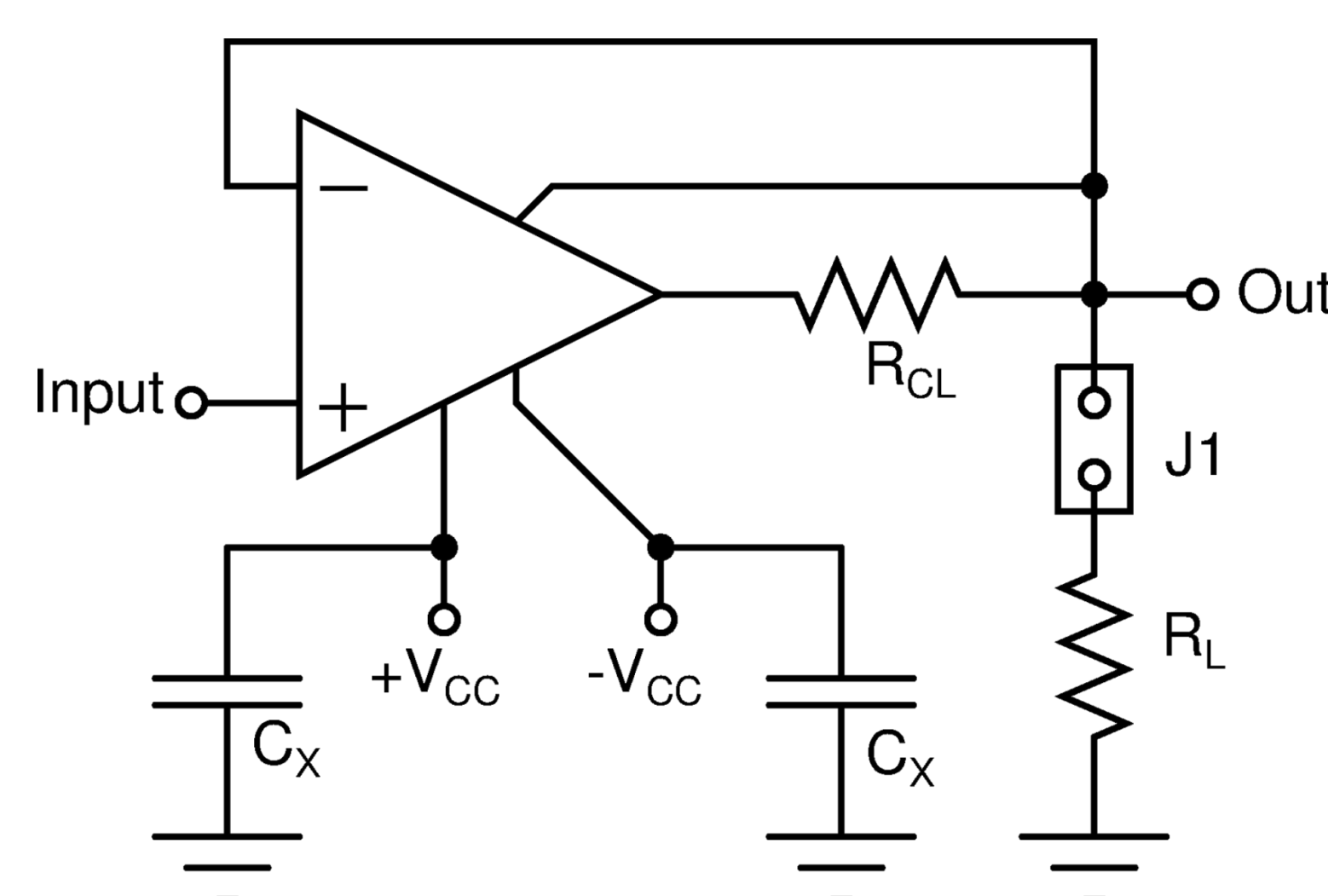
B. Electric parameters

- Slew Rate: 10-11 V/ μs .
- Saturation Voltage: 4 V.
- Output Current: Several Amperes.

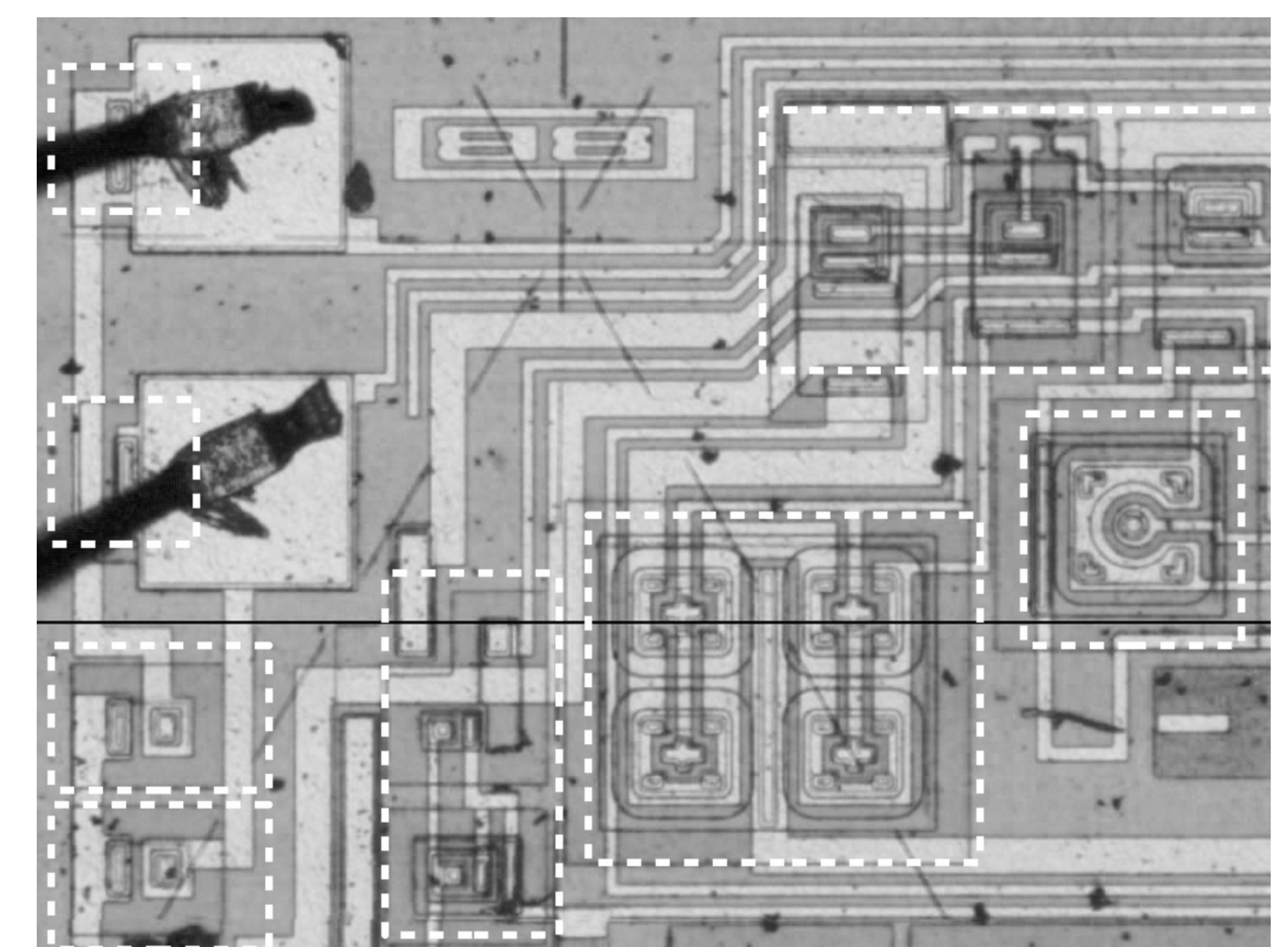
Tests Set-Up



Laser configuration and test set-up.
Laser wavelength 800nm.



Electric configuration during the tests.



Zoom of the upper left corner. Structures inside dashed white boxes were tested with the laser.

Results

No single event transients were observed in all of the possible bias conditions and spot locations.

Possible reasons of the tolerance

- ❑ Single event transients are often related to lateral PNP transistor. However, this device has mostly NPN transistors.
- ❑ The transistors inside this device must stand collector-base voltages about 80V. A way to increase the critical value of the breakdown voltage is decreasing the doping concentration of the transistors and avoiding sharp doping profiles using linear impurity distribution instead. In consequence, the depletion volume in the reverse-biased PN junctions is wider whereas the inner electric field weaker.
- ❑ A consequence of the reduction of the impurity concentration is the decrease of the parasitic junction capacitances and the increase of the total charge that the laser must remove to induce a single event transient.
- ❑ The array structure of the output stage can also help to protect the device against single event transients.

Conclusions

These tests have shown that the OPA541 might be good a candidate for use in electronic systems that work in radiation environments given its tolerance to total radiation dose and to the apparent absence of single event transients.