

# Charge-Sensitive Amplifier

## Electronic circuit with high sensitivity and bandwidth

### Invention

The charge-sensitive amplifier is an electronic circuit for amplifying the lowest voltages. It is suitable for the usual applications of an electrometer. This allows voltage and charge measurements on high impedance power sources. Due to the higher sensitivity and the very high bandwidth of the circuit additional applications are possible, where previous measuring devices were not sufficient.

Two junction gate field-effect transistors (JFETs) form a differential common-source input stage whose outputs lead via a follower emitter to an operational amplifier. In contrast to conventional circuits there is no negative feedback on the input by a high-impedance resistor. The leakage current of the FET at the input is compensated by the leakage current of an equivalent FET with the same temperature dependence. This results in an extremely high input impedance. The leakage current compensation is combined with a "bootstrap circuit", which ensures a high bandwidth.

The charge-sensitive amplifier which is available as a prototype can as well be operated as a voltage amplifier with an input capacitance of approx. 5 pF and an extremely high impedance. The circuit provides high sensitivity with sufficient drift stability to conduct measurements in the range of fC over a one second time. The bandwidth is about 1 MHz. Comparable charge amplifiers with similar sensitivity are intended for short pulses only and therefore not suitable for quasi-static measurements. On the other hand, there are electrometers with a very low bandwidth. This circuit closes this metrological gap. The input circuit with the combination of junction FETs is without any further assembly, intrinsically protected against electrostatic charge.

### Commercial Opportunities

The sensitivity and bandwidth is approx. 50 times higher compared to conventional amplifier circuits and requires no cooling like other approaches. The measuring task can be feasible in fields of physics, chemistry, biology and medicine with an affordable price.

In contrast to previous measuring devices, additional applications are possible due to higher sensitivity and the very high bandwidth of the circuit.

### Current Status

The university is holder of a patent application in Germany. International registrations are possible. On behalf of the University Duisburg-Essen, we offer interested companies the possibility of licensing and the further development of the technology.

An invention of University Duisburg-Essen.

### Competitive Advantages

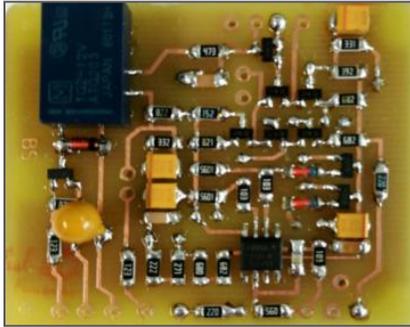
- Very high bandwidth
- High sensitivity
- Simple circuit concept
- Cheap production costs

### Technology Readiness Level

4

### Industries

- Measurement technology



Prototype charge-sensitive amplifier

### Contact:

Ref. No. 5488

Martin van Ackeren

### PROvendis GmbH

Schlossstrasse 11-15  
45468 Muelheim an der Ruhr  
Germany

Tel.: +49 (0) 208 94 105 34

Fax: +49 (0) 208 94 105 50

E-Mail: [ma@provendis.info](mailto:ma@provendis.info)

Web: [www.provendis.info](http://www.provendis.info)