Claims

1. A method for operating a piezoelectric MEMS sound transducer (4), in particular a MEMS loudspeaker and/or MEMS microphone operating in the audible wavelength spectrum and/or in the ultrasonic range,
in which electrical energy is stored in at least one energy store (2) and this electrical energy is transferred between the energy store (2) and the piezoelectric MEMS sound transducer (4) indirectly via at least one transfer unit (3, 13),
characterized in that
the at least one transfer unit (3, 13) and the piezoelectric MEMS sound transducer (4) are situated in a parallel circuit (5) with respect to one another and are connected in such a way that,
in order to operate the piezoelectric MEMS sound transducer (4) in a first switching state, the at least one transfer unit (3) is first of all charged from the energy store (2) and
this transfer unit (3) is then discharged again in a second switching state and the piezoelectric MEMS sound transducer (4) is charged in this case and, in order to recover energy in a third switching state, the piezoelectric MEMS sound transducer (4) is discharged again and the at least one transfer unit (3, 13) is charged in this case, and
this transfer unit (3, 13) is then discharged again in a fourth switching state and the energy store (2) is charged in this case, and the electrical energy in the energy store is increased in order to compensate for energy loss.

2. The method as claimed in the preceding claim, characterized in that the electrical energy is transferred step-by-step between the energy store (2)

and the piezoelectric MEMS sound transducer (4), and so the electrical energy is transferred in portions.

3. The method as claimed in one of the preceding claims, characterized in that, in order to operate the piezoelectric MEMS sound transducer (4), the electrical energy is first of all at least partially transferred from the energy store (2), on a first current path (6), to the first transfer unit (3), in the first switching state, and
the electrical energy is then at least partially transferred, in a first circuit (8), from the first transfer unit (3) to the piezoelectric MEMS sound transducer (4), in the second switching state, and,
in order to recover energy, the electrical energy of the piezoelectric MEMS sound transducer (4) is first of all transferred, in the first circuit (8), from the piezoelectric MEMS sound transducer (4) to the first charging unit (3), in the third switching state, and is then transferred, on the first current path (6), to the energy store (2), in the fourth switching state.

4. The method as claimed in one of the preceding claims, characterized in that, in the method, the electrical energy is transferred between the energy store (2) and the piezoelectric MEMS sound transducer (4) with the aid of a second transfer unit (13) and, in order to operate the piezoelectric MEMS sound transducer (4), the electrical energy is first of all at least partially transferred from the energy store (2), on at least one second current path (14), to the second transfer unit (13), in a fifth switching state, and the electrical energy is then at least partially transferred, in a second circuit (15), from the second transfer unit (13) to the piezoelectric MEMS sound transducer (4), in a sixth switching state, and
in order to recover energy, the electrical energy of the piezoelectric

MEMS sound transducer (4) is first of all transferred, in the second circuit (15), from the piezoelectric MEMS sound transducer (4) to the second charging unit (13), in a seventh switching state, and is then transferred, on the second current path (14), to the energy store (2), in an eighth switching state.

5. The method as claimed in one of the preceding claims, characterized in that electrical energy is transferred, on the second current path (14), from the energy store (2) to the second transfer unit (13) during the transfer of the electrical energy, in the first circuit (8), from the first transfer unit (3) to the piezoelectric MEMS sound transducer (4) and
electrical energy is transferred, on the first current path (6), from the energy store (2) to the first transfer unit (3) during the transfer of the electrical energy, in the second circuit (15), from the second transfer unit (13) to the piezoelectric MEMS sound transducer (4).

6. The method as claimed in one of the preceding claims, characterized in that the circuit (1) comprises a plurality of switching units (10) and/or switches (9) which are opened and/or closed in such a way, and comprises a plurality of diodes (16) which are situated in such a way that the various switching states can be formed, wherein the first current path (6), the second current path (14), the first circuit (8), and the second circuit (15) are interrupted and/or made to be conductive or are conductive, and so the electrical energy can be transferred between the energy store (2), the first transfer unit (3), the second transfer unit (13), and/or the piezoelectric MEMS sound transducer (4).

7. The method as claimed in one of the preceding claims, characterized in that the energy store (2), the first transfer unit (3), the second transfer unit

(13), and the piezoelectric MEMS sound transducer (4) form an electrical, in particular resonant, oscillating circuit, wherein the switches (9) and/or switching units (10) are preferably switched in such a way that the switching takes place in a current zero crossing of the particular oscillating circuit.

8. A circuit comprising
at least one energy store (2), in which electrical energy can be stored, a piezoelectric MEMS sound transducer (4), in particular a MEMS loudspeaker and/or MEMS microphone operating in the audible wavelength spectrum and/or in the ultrasonic range, at least one transfer unit (3, 13), a controller (17), a switching unit (10) and/or switches (9) that can be activated with the aid of the controller (17) to allow current paths to be interrupted or conducted such that electrical energy can be transferred between the energy store (2) and the piezoelectric MEMS sound transducer (4),
<u>characterized in that</u>
the at least one transfer unit (3, 13) and the piezoelectric MEMS sound transducer (4) are situated in a parallel circuit (5) with respect to one another and which can be operated with the aid of a method as claimed in one or multiple of the preceding claims.

9. The circuit as claimed in the preceding claim, <u>characterized in that</u>
the circuit (1) comprises a first transfer unit (3), wherein a first current path (6) extends through the first transfer unit (3) and a third current path (7) extends through the piezoelectric MEMS sound transducer (4), and wherein an electric current can be applied to the two current paths (6, 7) independently of one another.

10. The circuit according to claim 8 or 9, characterized in that the circuit (1) comprises a second transfer unit (13), wherein a second current path (14) extends through the second transfer unit (13) and the third current path (7) extends through the piezoelectric MEMS sound transducer (4), and wherein an electric current can be applied to the two current paths (14, 7) independently of one another.

11. The circuit according to any of claims 8-10, characterized in that the first transfer unit (3) and the second transfer unit (13) are situated in a parallel circuit (5), and so current can be applied to the first current path (6) and to the second current path (14) independently of one another.

12. The circuit according to any of claims 8-11, characterized in that the first transfer unit (3) and the piezoelectric MEMS sound transducer (4) are situated with respect to one another in such a way that a first circuit (8) is formed, and
the second transfer unit (13) and the piezoelectric MEMS sound transducer (4) are situated with respect to one another in such a way that a second circuit (15) is formed.

13. The circuit according to any of claims 8-12, characterized in that the first transfer unit (3) and the second transfer unit (13) comprise an energy storage unit, in particular a coil having an inductance, so that the electrical energy can be stored in the transfer units (3, 13).

14. The circuit according to any of claims 8-13, characterized in that the energy store (2) comprises a capacitor having a capacitance, so that the electrical energy can be stored therein.

15. The circuit according to any of claims 8-14, characterized in that the energy store (2), the first transfer unit (3), the second transfer unit (13) and the piezoelectric MEMS sound transducer (4) form an electrical, in particular resonant, oscillating circuit, and so the electrical energy stored in the electrical oscillating circuit is capable of oscillating between the particular components.

16. An integrated circuit, in particular an ASIC, which comprises a circuit (1) which is designed as claimed in any one of claims 8-15.