

### **Aluminium alloy for lead frames**

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The invention relates to the utilization of an AA6XXX aluminium alloy for electrical connections of electrical components of an electrical circuit or of semiconductor components, a stamped part for an electrical connection of electrical components of an electrical circuit or semiconductor components, a method for manufacturing the stamped parts and a method for manufacturing an electrical circuit or a semiconductor component using the stamped parts.

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To provide electrical connections of electrical components in electrical circuits or semiconductor components, so-called stamped grids of metal or lead frames are also used. For example, metal stamped grids are used in motor vehicles to connect components of an electrical circuit in as tight a space as possible without additional cable connections being required. These stamped grids are normally manufactured from a copper alloy and not only serve to conduct the electric current between the components, but also undertake the removal of heat from the electrical components. The thickness of the stamped grids is, for example 0.2 mm to 2 mm. Appropriate stamped grids are often also used for power electronics to provide as low an electrical resistance as possible for stronger currents.

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In their housings, semiconductor components also have electrical connections of electrical components which are provided by so-called lead frames. Appropriate lead frames having thicknesses in the range of maximum 0.3 mm, preferably maximum 0.2 mm, are connected to the respective semiconductor components and encapsulated in a housing. To this end, a semiconductor chip must first be connected to the lead frame in a thermally or electrically conductive manner. This process is called "die bonding". The lead frames are electrically connected to the semiconductor chips by bond wires with diameters in the range of 15  $\mu\text{m}$  to 100  $\mu\text{m}$  by "wire bonding", in which the bond wires are often welded to the semiconductor chip itself and to the lead frame using ultrasonic welding so that an electrical connection is created between them. Subsequently, the housing of the semiconductor component is cast and thermally cured, for example by a transfer mould method. Typical semiconductor components are,

for example, integrated circuits (ICs), which can be electrically connected to other electrical components via outer contacts belonging to the lead frame.

5 In "die bonding", "wire bonding" and "moulding", as well as in the curing of the housing, the so-called "post-mould curing", the lead frame is exposed to heating to temperatures of over 150°C to a maximum of 380°C.

10 Stamped grids and lead frames have so far usually been manufactured from copper or a copper alloy. The copper alloy CuNi2,5SiZn, for example, can be regarded as a known copper alloy which meets the properties required for the mass production of semiconductor components in relation to the tensile strength, yield strength, electrical conductivity, thermal conductivity, thermal expansion and hardness of the alloy.

15 However, a disadvantage of the copper alloys used is that the raw material price of the precious metal copper is very high. Furthermore, due to the relatively high strength of the copper alloy, the stamping tools are subject to increased wear, which also leads to higher costs in production.

20 Aluminium has therefore been considered a substitute material for these applications in the past. The use of a lead frame consisting of an aluminium alloy of type AA3XXX and AA6XXX is known from US patent US 5,066,368. The aluminium alloys of type AA3003 are preferably used according to the US patent.

25 It is known from international patent application WO 92/04729 to achieve an improved adhesion of the cast housing of a semiconductor component by coating the lead frame, said international patent application also preferring an aluminium alloy of type AA3003.

30 The preferred aluminium alloy types AA3003 and the attempts with aluminium alloys of type AA5000 failed in particular due to mechanical properties diverging too greatly after the manufacture of, for example, semiconductor components. For instance, softening procedures in AA3000 and AA5000 materials occur due to the heat treatment in the die bonding, wire bonding, or moulding and post-mould curing. In addition, the electrical conductivity in aluminium alloys of type 5000 with high magnesium content was previously not sufficiently high.

On this basis, the object underlying the invention is to propose an aluminium alloy for electrical connections of electrical components of an electrical circuit or of semiconductor components with which the problems previously known from the state of the art can be solved.

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According to a first teaching of the present invention, the object outlined above is achieved by the aluminium alloy having a composition of type EN AW 6060, EN AW 6063 or EN AW 6016.

10 In simulated annealings which imitate the process steps for manufacturing electrical connections of electrical semiconductor components, an electrical circuit or of semiconductor components, it has been found that these can be used for artificial age hardening the above-mentioned aluminium alloy types and can thus provide mechanical, thermal and electrical properties similar to the copper alloy. In particular,  
15 the values for the yield strength of the above-mentioned aluminium alloys in state T6, that is after artificial ageing, are very close to the yield strength values of the previously preferred copper alloys used, so that the utilization of the above-mentioned specific aluminium alloy types is enabled for the provision of thermal and/or electrical connections of electrical components of an electrical circuit or of semiconductor  
20 components. All three aluminium alloy types have particularly good electrical conductivity in the artificially aged state T6. It has also been found that the aluminium alloy of type EN AW 6016 reaches even higher values with regard to strength and yield strength than the aluminium alloy of type EN AW 6063. In particular, it has a greater hardness in state T6 than the alloy of type EN AW 6063.

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The aluminium alloy is preferably used as a stamped part, as a stamped lead frame or as a stamped grid for the electrical connection of the electrical components or of semiconductor components. Due to the age hardenability of the aluminium alloys of type EN AW 6060, EN AW 6063 or EN AW 6016, it is possible to firstly manufacture the  
30 stamped parts in a soft, readily formable state, for example in state T4, so that the stamping and forming can take place without problems and with little wear on the stamping tools. Through heat treatments, in the case of the alloys mentioned, the strength and yield strength values can be adapted to the downstream process steps to

provide electrical circuits, or to the manufacture of semiconductor components. To this end, process steps containing a heat treatment can also be used.

According to a further configuration, an aluminium strip, an aluminium foil or a sheet of the aluminium alloys in state T4 is used to manufacture the stamped parts. State T4 is achieved by the manufactured aluminium strip, foil or sheet being solution annealed after cold rolling and subsequently quenched, so that as many alloying elements as possible remain in solid solution in the aluminium matrix and provide a highly formable material. In stamping, use can be made of the high degree of forming in addition to the low wear.

According to a second teaching of the present invention, the object outlined above is achieved by a stamped part for an electrical connection of electrical components of an electrical circuit or semiconductor components in that the stamped part at least partly consists of an aluminium alloy of type EN AW 6060, EN AW 6063 or EN AW 6016.

As already stated above, the aluminium alloys mentioned, in particular in state T6 after artificial ageing, exhibit the mechanical, electrical and thermal properties necessary for the provision of an electrical connection of electrical components of an electrical circuit or of semiconductor components. Softening of the aluminium alloy does not take place during the thermal loading until the completion of the electrical circuit or the semiconductor component. In addition, appropriate stamped parts can be manufactured more cost-effectively than stamped parts consisting of a copper alloy, as the aluminium strips to be stamped can be easily formed in state T4 and the wear on the stamped tools remains low.

If the stamped parts are manufactured from an aluminium foil with a thickness of 20  $\mu\text{m}$  to 200  $\mu\text{m}$  or an aluminium strip with a thickness of 0.2 mm to 2 mm, lead frames and stamped grids can be provided which have dimensions customised for use in semiconductor components and also in electrical circuits. For electrical circuits with higher power and thus higher currents, the stamped parts are preferably manufactured from an aluminium alloy strip with a thickness of 200  $\mu\text{m}$  to 2 mm. Preferably, however, in the case of lead frames for semiconductor components, intermediate thicknesses are

also used, for example of 80  $\mu\text{m}$  to 300  $\mu\text{m}$  or 250  $\mu\text{m}$ , which have a preferred range for the thickness of the strips or foils from which the lead frames are manufactured.

According to a configuration of the stamped part, the aluminium alloy of the stamped part, after the manufacture of the electrical circuit or the semiconductor component, is, at least in areas, in an artificially aged state and/or in state T6. The artificial ageing properties of the preferred aluminium alloys of type EN AW 6063 or EN AW 6016 result in the mechanical, electrical and thermal properties necessary for the use of the semiconductor components or the electrical circuits as lead frames or electrical connections for electrical components.

The stamped parts are, at least in areas, preferably surface-treated, in particular coated. Possible surface treatments are, for example, anodisations, claddings or galvanisations. An anodisation increases, for example, the aluminium's resistance to oxidation considerably. Other coatings, a copper coating or gold coatings enable the utilization of specific production techniques, for example ultrasonic wire bonding.

The stamped part is preferably a lead frame of a semiconductor component or a stamped grid of an electrical circuit. Lead frames are normally manufactured in high-speed progressive tools from a base material in strip form, for example from an aluminium strip. In contrast, stamped grids can also be manufactured as individual parts. Lead frames differ from stamped grids on the one hand due to their lower thicknesses; on the other hand, in the case of lead frames, the support frame is usually separated in a final stamping step after the manufacture of the semiconductor component, whereas the stamped grid normally becomes a full part of the electrical circuit in a printed circuit board. Both forms of the stamped parts therefore enable the manufacturing process to be automated to a particularly high degree with the raw material price of the base material being simultaneously reduced.

According to a further teaching of the present invention, the object outlined above is achieved by a method for manufacturing stamped parts for electrical connections of components of an electrical circuit or of semiconductor components with the following steps:

- providing a strip, foil or sheet consisting of an aluminium alloy according to Claim 1,
- 5       - solution annealing and quenching the strip, foil or sheet such that the strip, foil or sheet is present in state T4,
- stamping the strip, foil or sheet to provide electrical connections of components of an electrical circuit.

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As already stated above, in state T4 the stamped parts can benefit from the very good forming behaviour of the aluminium alloy tool so that highly precise stamping processes and forming processes can be used in order to provide lead frames and stamped grids.

15       Preferably after the stamping of the strip, foil or sheet in state T4, natural ageing and/or artificial ageing is carried out before further processing. This natural ageing and/or artificial ageing can allow, for example, a very specific state of the strip, foil or sheet, or of the stamped parts manufactured therefrom, to be set so that electrical circuits or semiconductor components can be produced at a high speed. For example, other age  
20       hardening states can be used, e.g. a state T5, in order to achieve starting from state T4 specific tensile strength values or yield strength values adapted to the processing to be used, in order to finally achieve the maximum strength T6 only after a further heat treatment.

25       According to a subsequent configuration of the method the strip, foil or sheet is manufactured by a method having the following method steps:

- discontinuous casting of a rolling ingot, preferably by the DC method (direct chill)
- 30       - homogenising the rolling ingot,
- hot rolling of the rolling ingot and

- cold rolling the hot strip with or without intermediate annealing to the final thickness, wherein the strip is rolled to a final thickness of 0.2 mm to 2 mm and the foil to a final thickness of 20  $\mu\text{m}$  to 200  $\mu\text{m}$ .

5 As an alternative to discontinuous casting, the strip can be manufactured by continuous casting of a cast strip according to a further configuration and the cast strip cold-rolled by hot or cold rolling to a final thickness of 20  $\mu\text{m}$  to 200  $\mu\text{m}$  into the foil or to a final thickness of 0.2 mm to 2 mm into the strip.

10 Both method steps, the discontinuous casting of a rolling ingot with its corresponding method steps and the continuous casting of a cast strip and the further method steps for manufacturing a foil or a band enable stamped parts to be manufactured in a highly economic manner from the aluminium alloy material according to the invention, said stamped parts satisfying the requirements for the provision of electrical connections or  
15 thermal connections of components of an electrical circuit or of semiconductor components.

Finally, the object outlined above is achieved by a fourth teaching of the invention by manufacturing an electrical circuit or a semiconductor component using stamped parts  
20 according to the invention. The stamped parts, in particular stamped grids or lead frames, have the necessary mechanical, electrical and thermal properties due to the aluminium alloy used. In addition, the costs of manufacturing corresponding electrical circuits or semiconductor components can be further reduced due to the lower raw material costs for the lead frames.

25 The stamped parts preferably undergo in areas at least one surface treatment, for example plating, anodising, galvanising or coating, during the manufacture of an electrical circuit or a semiconductor component. By this surface treatment specific areas of the stamped parts can be adapted to the respective object. For example, a coating  
30 with an ultrasonic bondable surface enables the use of ultrasonic wire or wire bonders to electrically contact the semiconductor chip with the lead frame. Other needs can be, for example, coating with a soft solder or a corrosion protection layer. Simultaneously,

surface coating can also be applied by coating with an insulation material, or a treatment for further corrosion protection can be carried out.

The method is more preferably configured in that the stamped parts undergo, before, during or after they are processed into an electrical circuit or a semiconductor component, heat treatment steps for hardening the aluminium alloy. The aluminium alloys of type EN AW 6063 and EN AW 6016 are characterised in that various tempering states can provide different strengths and hardness. To this extent, the curing degree of the aluminium alloy can be specifically adapted to the properties of the manufacturing method.

The invention shall be explained in greater detail below using an exemplary embodiment in conjunction with the drawings.

In the drawings

Fig. 1 shows a first exemplary embodiment of a typical configuration of a lead frame,

Fig. 2 shows a second exemplary embodiment of a stamped part in the form of a stamped grid of an electrical circuit and

Fig. 3 is a schematic representation of the method steps for manufacturing electrical connections or electrical semiconductor components.

First, Fig. 1 shows a top view of a lead frame 1 which can be used to manufacture semiconductor components, in particular integrated circuits. The typical structure of the lead frame 1 for so-called ICs (integrated circuits) has various areas which must have different properties. The connecting contacts 3 are thus arranged, after being manufactured, outside the housing or package of the semiconductor component and serve to establish electrical contact of the semiconductor component with the contacts of an electrical circuit. The connection points should have a certain mechanical strength in order to also be automatically processed via placement machines.

The so-called "die pad" 2 (chip pad) serves to attach the semiconductor chip. The lead frame 1 is manufactured from an aluminium alloy of type EN AW 6060, EN AW 6063 or EN AW 6016. The thickness of the lead frame is preferably 0.08 mm to 0.25 mm or a maximum of 0.3 mm. The chip pad area and in particular the contact points 4 of the lead frame with which electrical contact is established by a wire bonding method can be selectively coated. For example, a specific gold coating can be provided for the wire bonding which enables the ultrasonic wire bonding method.

In addition, it is possible to provide the chip pad 2 with a coating with high thermal conductivity by which the chip can also be glued to the chip pad. In the manufacture of the lead frame 1, a stamping process is performed by a high-speed progressive tool, resulting in the geometry of the lead frame as shown in Fig. 1. It has been found that, in particular, aluminium alloys of type EN AW 6060, EN AW 6063 or EN AW 6016 in state T4 are particularly suitable for undergoing appropriate stamping processes. They are particularly characterised by good formability and a high level of malleability and stampability.

Fig. 2 shows part of an exemplary embodiment of a stamped grid 5 which can also be manufactured from an aluminium alloy of type EN AW 6060, EN AW 6063 or EN AW 6016. The stamped grid 5 has significantly larger structures than the lead frame 1 and serves to establish electrical contact to electrical components of an electrical circuit, for example of an ABS or ESP control of a motor vehicle. Stamped grids 5 are also used to electrically connect lighting elements in the motor vehicle. In addition, there are other applications of stamped grids for provision of thermal and/or electrical connections of electrical components which are positioned on the stamped grids 5 and electrical contact is established with them.

The establishing of electrical contact is normally carried out by a soldering method or using conductive and curable adhesives. In addition to the electrical connections, both lead frames 1 and stamped grids 5 serve to remove heat from the components of the electrical circuit and thus also to provide thermal connections of the components of an electrical circuit or in the semiconductor component.

The thermal and/or electrical connections displayed in Figures 1 and 2 of electrical components of an electrical circuit or of semiconductor components in the form of lead frames or stamped grids are manufactured according to the invention from an aluminium alloy of type EN AW 6060, EN AW 6063 or EN AW 6016.

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The aluminium alloy of type EN AW 6060 has the following alloying elements in wt. %:

$0.30 \% \leq \text{Si} \leq 0.6 \%$

$0.10 \% \leq \text{Fe} \leq 0.30 \%$ ,

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Cu max. 0.10 %,

Mn max. 0.10 %,

$0.35 \% \leq \text{Mg} \leq 0.6 \%$ ,

Cr max. 0.05 %,

Zn max. 0.15 %,

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Ti max. 0.10 %,

residual Al and unavoidable impurities: individually max. 0.05 wt.%, in total max. 0.15 wt.%.

The aluminium alloy of type EN AW 6063 has the following alloying elements in wt. %:

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$0.20 \leq \% \text{Si} \leq 0.6 \%$

Fe max. 0.35 %,

Cu max. 0.10 %,

Mn max. 0.10 %,

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$0.45 \% \leq \text{Mg} \leq 0.9 \%$ ,

Cr max. 0.10 %,

Zn max. 0.10 %,

Ti max. 0.10 %,

residual Al and unavoidable impurities: individually max. 0.05 wt.%, in total max. 0.15 wt.%.

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The aluminium alloy of type EN AW 6016 has the following alloying elements in wt. %:

1.0 %  $\leq$  Si  $\leq$  1.5 %,

Fe max. 0.50 %,

Cu max. 0.20 %,

Mn max. 0.20 %,

5 0.25 %  $\leq$  Mg  $\leq$  0.6%,

Cr max. 0.10 %,

Zn max. 0.20 %,

Ti max. 0.15 %,

10 residual Al and unavoidable impurities: individually max. 0.05 wt.%, in total max. 0.15 wt.%.

All three aluminium alloys EN AW 6060, EN AW 6063 and EN AW 6016 are characterised by moderate to low Mg contents, low upper limits for copper and manganese contents, as well as moderate iron contents. The properties with regard to the thermal and electrical conductivity of the aluminium alloys also in the artificially aged state as well as the mechanical properties necessary in relation to the use as electrical connections of components of an electrical circuit or of semiconductor components are attributed to the selected combination of these alloying elements.

20 Although no measurements of the aluminium alloy type EN AW 6060 regarding the electrical/thermal conductivity in the artificially aged state have previously been performed, it is assumed that due to the alloy composition, values are achieved which are similarly good compared to the values presented below for the aluminium alloy of type EN AW 6063 and EN AW 6016.

25 All measurements mentioned were performed in accordance with the relevant EN standard.

30 The aluminium alloy of type EN AW 6016 has, in comparison to the aluminium alloy of type EN AW 6063, a surplus of silicon and can therefore provide higher strengths than the aluminium alloy of type EN AW 6063, for example in state T6.

As Table 1 shows, the aluminium alloy of type EN AW 6063 has, in tempering state T6, that is after artificial ageing, a yield strength which lies at least in the range of the yield strength of the preferred copper alloy CuNi2.5SiZn of 250 MPa. In addition, the electrical conductivity lies, at 52%, above that of the copper alloy indicated in Table 1 with the unit % IACS expressing the conductivity as a percentage value of the conductivity of pure, annealed copper (corresponding to 100% IACS) which corresponds to a conductivity of 58 MS/m.

By the tempering state of the alloy intermediate values such as T5 can also be provided, like in the exemplary aluminium alloy of type EN AW 6063 given here, enabling appropriate specific values to be provided by the tempering state for the tensile strength, yield strength and also Vickers hardness. The tempering states of the aluminium alloys of type EN AW 6063 and EN AW 6016 can to this extent be specifically adapted to requirements of the production process of electrical circuits or semiconductor components in order to provide optimal process conditions.

The aluminium alloys according to the invention are preferably brought into state T4, which is provided by solution annealing and quenching of a cold-rolled aluminium alloy strip. In state T4, the aluminium alloys of type EN AW 6060, EN AW 6063 and EN AW 6016 have a particularly high formability and enable the stamped parts to undergo a precise stamping procedure.

In addition, it is clear from Table 1 that the tensile strength values, the yield strength values and the electrical conductivity of the aluminium alloys of type EN AW 6016 are almost identical to the values which are reached for the copper alloy CuNi2.5SiZn in tempering state R360. The aluminium alloy EN AW 6016 is therefore particularly suitable in state T6 as a substitute for the previously used copper alloy.

The comparison alloys of type EN AW 5182 or EN AW 3004 are subjected to softening by heat treatments in the manufacture of electrical circuits or semiconductor components, such that the soft-annealed states O are indicated here. As can clearly be seen, an alloy of type EN AW 3004 has significantly lower mechanical strength values and hardness values than the reference copper alloy CuNi2.5SiZn. The alloy EN AW

5182 does reach the strength values. However, its significantly lower electrical conductivity shows that it is not suitable as a substitute for the normally used copper alloy.

- 5 Fig. 3 is a schematic representation of the method steps for manufacturing electrical connections of components of an electrical circuit or of semiconductor components. In manufacturing step A, an aluminium strip or an aluminium foil is first manufactured from one of the two aluminium alloys of type EN AW 6060, EN AW 6063 or EN AW 6016. The manufacturing in step A is carried out by discontinuous casting of a rolling ingot, homogenising the rolling ingot, hot rolling the rolling ingot into a hot strip, and  
10 cold rolling the hot strip with or without intermediate annealing to the final thickness, wherein the strip has a final thickness of 0.2 mm to 2 mm or the foil a final thickness of 20  $\mu\text{m}$  to 200  $\mu\text{m}$ . Final thicknesses of 0.10 mm to 0.30 mm are preferably used.
- 15 As an alternative to providing the strip by casting a rolling ingot, preferably using the direct chill method, continuous casting can also be used to provide a cast strip with subsequent hot rolling and cold rolling with or without intermediate annealing in order to provide an aluminium strip with a final thickness of 0.2 mm to 2 mm or an aluminium foil with a final thickness of 20  $\mu\text{m}$  to 200  $\mu\text{m}$ .
- 20 In method step B according to the exemplary embodiment from Fig. 3, the heat treatment of the manufactured strip or the foil is performed by annealing the strip or the foil with subsequent quenching. In this way state T4 is set in the aluminium alloy strip or in the aluminium alloy foil. The stamping of the lead frame, the stamped grid or  
25 the stamped parts from the foil or the strip subsequently takes place in method step C.
- The final method step D depends on whether a stamped grid or a lead frame is manufactured. In method step D, the heat treatments of the lead frames can, for example, take place in the manufacture of a lead frame by chip bonding, wire bonding  
30 and manufacturing the housing of the semiconductor component during the "moulding" and the "post-mould curing" step, so that this is present in state T6 at the end of method step D and can provide the appropriate mechanical properties.

The same also applies if a manufactured stamped grid undergoes, in the manufacture of electrical and/or thermal connections of components of an electrical circuit, for example, soldering methods or extrusion-coating with plastic, with a heat input being made into the stamped grids 5.

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Alternatively or cumulatively, however, the stamped grid and the lead frame can also undergo, for example, artificial ageing or natural ageing in a parallel method step E in order to immediately provide the necessary mechanical properties in method step D.

10 Surface treatment steps can additionally take place in method step D in order to prepare certain areas of the stamped grid or the lead frame for the relevant technical use, for example "chip bonding", "wire bonding" or a soldering process.

15 It is particularly preferable to use the stamped grids and lead frames for the provision of power electronics, as the conductivity values of the aluminium alloys lie above those of the previously used copper alloys. Further uses are, for example, the provision of stamped grids for the electronics in a motor vehicle or in machine controls or the like to avoid cable connections.

20 The stamped grids can, for example, provide the conductive paths of a printed circuit board (not displayed here). The stamped grids are sometimes also directly assembled and soldered with components so that the soldering method allows the alloy to cure into state T6.

25 Unlike other AA6xxx alloys, the alloy variants according to the invention EN AW 6060, EN AW 6063 and EN AW 6016 provide particularly high strengths in state T6 with good corrosion resistance and improved electrical conductivity compared to the normally used copper alloy.

Table 1

| Alloy       | Tempering state | $R_m$ [MPa] | $R_{p0,2}$ [MPa] | Electrical conductivity [% IACS] | Thermal conductivity [W/mK] | Thermal expansion $10^{-6}$ [m/K] | Hardness [HV] |
|-------------|-----------------|-------------|------------------|----------------------------------|-----------------------------|-----------------------------------|---------------|
| CuNi2.5SiZn | R360            | 360 - 430   | 250              | 43                               | 185                         | 17                                | 100-130       |
| EN AW 3004  | O               | 170         | 60               | 42                               | 160                         | 23,2                              | 46            |
| EN AW 5182  | O               | 280         | 110              | 31                               | 126                         | 23,8                              | 75            |
| EN AW 6063  | O               | 100         | 50               | 57,5                             | 218                         | 23,5                              | 55            |
| EN AW 6063  | T4              | 160         | 90               | 49,5                             | 197                         | 23,5                              | 50            |
| EN AW 6063  | T5              | 215         | 175              | 55,5                             | 209                         | 23,5                              | 65            |
| EN AW 6063  | T6              | 245         | 210              | 52                               | 201                         | 23,5                              | 80            |
| EN AW 6016  | T6              | 280         | 235              | 46-49,5                          | 190                         | 23,5                              | 85            |

### Claims

1. Use of an AA6xxx aluminium alloy for electrical connections of electrical components of an electrical circuit or of semiconductor components, characterised in that the aluminium alloy has a composition of type EN AW 6016.
2. Use according to Claim 1, characterised in that the aluminium alloy is used as a stamped part or stamped grids (5) for the electrical connection of the electrical components or semiconductor components.
3. Use of an AA6xxx aluminium alloy for stamped lead frames of semiconductor components, characterised in that the aluminium alloy has a composition of type EN AW 6060, EN AW 6063 or EN AW 6016.
4. Use according to any one of Claims 1 to 3, characterised in that an aluminium strip, an aluminium foil or a sheet of the aluminium alloys in state T4 is used to manufacture the stamped parts.
5. Stamped part for an electrical connection of electrical components of an electrical circuit or semiconductor components, characterised in that the stamped part consists at least partly of an aluminium alloy of type EN AW 6060, EN AW 6063 or EN AW 6016.
6. Stamped part according to Claim 5, characterised in that

the stamped part is manufactured from an aluminium alloy foil with a thickness of 20  $\mu\text{m}$  to 200  $\mu\text{m}$  or an aluminium alloy strip with a thickness of 200  $\mu\text{m}$  to 2 mm and optionally has state T4.

- 5        7.    Stamped part according to Claim 5 or 6,  
characterised in that  
the aluminium alloy of the stamped part, after the manufacture of the electrical  
circuit or the semiconductor component, has an artificially aged state at least in  
areas and/or is in state T6 in areas.
- 10       8.    Stamped part according to any one of Claims 5 to 7,  
characterised in that  
the stamped part is a stamped grid (5) of an electrical circuit.
- 15       9.    Lead frame of a semiconductor component,  
characterised in that  
the lead frame consists at least partly of an aluminium alloy of type EN AW 6060,  
EN AW 6063 or EN AW 6016.
- 20       10.   Method for manufacturing stamped parts for electrical connections of components  
of an electrical circuit or of semiconductor components with the following steps:  
-    providing a strip, foil or sheet consisting of an aluminium alloy of type EN AW  
     6060, EN AW 6063 or EN AW 6016,  
-    solution annealing the strip, foil or sheet and quenching such that the strip, foil  
25    or sheet is present in state T4,  
-    stamping the strip, foil or sheet in state T4 to provide electrical connections of  
     components of an electrical circuit.
- 30       11.   Method according to Claim 10,  
characterised in that  
after the stamping of the strip, foil or sheet in state T4, natural ageing and/or  
artificial ageing takes place before further processing.

12. Method according to Claim 10 or 11,

characterised in that

the strip, foil or sheet is manufactured by a method having the following method steps:

- discontinuous casting of a rolling ingot,
- homogenising the rolling ingot,
- hot rolling the rolling ingot into a hot strip, and
- cold rolling the hot strip with or without intermediate annealing to the final thickness, wherein the strip is rolled to a final thickness of 0.2 mm to 2 mm and the foil to a final thickness of 20  $\mu$ m to 200  $\mu$ m.

13. Method according to any one of Claims 12,

characterised in that

as an alternative to discontinuous casting, a cast strip is manufactured by

continuous casting and the cast strip is cold-rolled by hot or cold rolling to a final thickness of 20  $\mu$ m to 200  $\mu$ m into the foil or to a final thickness of 0.2 mm to 2 mm into the strip.

14. Method for manufacturing an electrical circuit or a semiconductor component

using stamped parts according to any one of Claims 5 to 9.

15. Method according to Claim 14,

characterised in that

the stamped parts undergo at least one surface treatment in areas.

16. Method according to Claim 14 or 15,

characterised in that

the stamped parts, before/during or after being processed into an electrical circuit or a semiconductor component, undergo heat treatment steps for hardening the aluminium alloy.