Document US 7 647 110 B2 describes a modular implant. Different connector modules, electronics modules, and battery modules may be combined to realise different functions.

Document EP 2 493 557 B1 discloses a modular header for an implant. The header is constructed from a number of modules that are connected to each other. The length of the header may be adjusted by the number of modules.

Document US 2018/0054034 A1 discloses a modular connector of which the length may be adjusted by means of the number of modules used.

Document US 9 713 717 B2 discloses an implant having an electronics module which is formed on a substrate. Some components of the electronics module, such as filter capacitors or blocking capacitors, are embedded in the substrate.

Summary

One aspect may provide an improved technology for implants. In particular, the production of an active medical implant is to be simplified.

An implant according to claim 1 is disclosed. Further embodiments are the subject of dependent claims.

According to one aspect, an implant having a housing is provided. An energy store and an electronics module are arranged in the housing. A feedthrough to an electrode connection device is formed on the housing. A first contact forms an electrical connection between the energy store and the electronics module. A second contact forms an electrical connection between the electronics module and the feedthrough. The first contact and the second contact are oriented in the same contact direction.

The implant may be an active medical implant, for example an implantable pacemaker or an implantable cardioverter-defibrillator (ICD).

Fig. 2 shows an exploded view of an embodiment of an implant,

Fig. 3 shows a perspective view of a part of the implant according to Fig. 2,

Fig. 4 shows a side view of an implant,

Fig. 5 shows a detail of the electronics module,

Fig. 6 shows a further detail of the electronics module,

Fig. 7 shows a block diagram of the implant,

Fig. 8 shows a side view of the electronics module (upper image of Fig. 8), a view of the electronics module from below (middle image of Fig. 8) and a view of the electronics module from above (lower image of Fig. 8),

Fig. 9 shows a perspective view of the top side of the electronics module (upper image of Fig. 9) and a perspective view of the underside of the electronics module (lower image of Fig. 9),

Fig. 10A - 10E show a production process for the electronics module,

Fig. 11 shows a perspective view of an embodiment of an assembly for an electrode connection device,

Fig. 12 shows a front view (upper image of Fig. 12) and a rear view (lower image of Fig. 12) of the assembly according to Fig. 11,

Fig. 13 shows the assembly according to Fig. 11 and 12 with potting aids,

Fig. 14 shows the assembly according to Fig. 11 to 13 with an antenna and conductors,

Fig. 15 shows the assembly according to Fig. 11 to 14 arranged on a housing,

Fig. 16 shows the assembly according to Fig. 11 to 15 completely potted (with potting aids),

Fig. 17 shows the assembly according to Fig. 11 to 15 completely potted (without potting aids), and

Fig. 18 shows another embodiment of an implant.

Fig. 2 shows an embodiment of an implant. The implant comprises a two-part housing 60 with a first housing shell 60a and a second housing shell 60b. An electronics module 61 and an energy store 62 (for example a battery) are arranged in the housing 60. The energy store 62 is electrically insulated from the housing 60 by means of an insulating cover 64. The electronics module 61 is arranged on a front side 68 of the energy store 62. A first pin element is arranged on the front side 68 of the energy store 62 and comprises two pins 66a, 66b oriented parallel to each other. Associated with the first pin element is a first pin receptacle which comprises two ring-shaped pin receptacles 67a, 67b and which is arranged on the electronics module 61. By means of the first pin element 66a, 66b and the first pin receptacle 67a, 67b, an electrical connection is formed between the energy store 62 and the electronics module 61. The electronics module 61 is connected to a feedthrough 65. Details of the connection are explained in greater depth below. An electrode connection device 63 is arranged on the housing 60 and is connected to the electronics module 61 by means of the feedthrough 65.

The feedthrough 65, the electronics module 61 and the energy store 62 are assembled along an axis (here along the z-direction). The direction of the axis is determined by the direction

electrode connection device 53 may be formed, for example, according to the embodiment shown in Fig. 11 to 17. The feedthrough 65 with the pins 70 is welded into the cover 121.

One or more embodiments of the implant and methods disclosed herein may have one of more of the following advantages:

The internal structure of the electronic implant is significantly simplified, thus reducing production costs. Similarly, the number and complexity of the required production processes decreases, thus favouring the scalability of production (for example simplified transfer to other locations, reduced training needs for employees, reduced requirements for the required manufacturing environment and accompanying engineering). Furthermore, reworking becomes possible or simplified when detachable joining techniques are used.

With the form factor of the electronics module, the implant may be made smaller or the volume gained may be used to increase battery capacity and thus extend the service life of the implant. The production of the electronics module in µBGA technology enables an increase in the usefulness on the panel and an associated production cost saving. The vertical assembly of the electronics module (parallel to the front side of the energy store) enables electrical connections without angles and thus a simpler, more economical construction of the implant, optimised for automatic manufacturing in one axis.

The features disclosed in the description, the claims and the figures may be relevant for the realisation of embodiments both individually and in any combination with each other.

Claims

1. An implant comprising an electronics module and an energy store, wherein the volume of the electronics module is less than 25% of the volume of the energy store, wherein the electronics module has a substrate, on which there are arranged a plurality of components, wherein the area of the substrate is smaller than or equal to the area of a front side of the energy store.

2. The implant according to claim 1, wherein the ratio of the length of the electronic module to the width of the electronic module is 4:1 or more.

3. The implant according to claim 1 or 2, wherein the width of the electronic module is less than or equal to the width of the energy store.

4. The implant according to one of the preceding claims, wherein the length of the electronic module is less than or equal to the length of the energy store.

5. The implant according to one of the preceding claims, further having an electrode connection device, wherein the length of the electronic module is less than or equal to the length of the electrode connection device, and/or wherein the width of the electronics module is less than or equal to the width of the electrode connection device.

6. The implant according to claim 5, wherein the length of the energy store is less than or equal to the length of the electrode connection device, and/or wherein the width of the energy store is less than or equal to the width of the electrode connection device.

7. The implant according to one of the preceding claims, wherein some of the plurality of components have a minimum structure size of $F \leq 90$ nm.

8. The implant according to one of the preceding claims, wherein at least one of the plurality of components is arranged on a first side of the substrate, and wherein at least one other of the plurality of components is arranged on a second side of the substrate.

9. The implant according to one of the preceding claims, wherein some of the plurality of components are arranged as SMD elements on the substrate.

10. The implant according to claim 9, wherein some of the plurality of components are arranged in one or more Ball Grid Array (BGA) packages and/or Multi Chip Module (MCM) packages and/or as bare integrated circuits on the substrate.

11. The implant according to one of claims 1 to 8, wherein some of the plurality of component are arranged side by side or on top of each other on one side of the substrate, wherein the components are each connected to the substrate, and wherein the components are encapsulated with a potting agent.

12. The implant according to claim 11, wherein holes for a connection contact for the energy store and/or for a further connection contact for a feedthrough are formed in the potting agent.

13. The implant according to one of the preceding claims, wherein the electronics module is formed as a multi-chip module.

14. The implant according to one of claims 5 to 13 insofar as referred back to claim 5, wherein a feedthrough to the electrode connection device is formed as a
- integral component of the electronics module,
- SMD component on the electronics module, or
- plug-in connection on the electronics module.