

15 JUL 2002

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DESCRIPTION



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HOUSING FOR A DEVICE



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The invention relates to a housing for a device in accordance with the introductory section of claim 1.

Housings for devices in a wide range of different forms made from a variety of different materials are known as such, particularly for electrical and electronic devices and measuring instruments. Chassis to hold the components of the equipment in question are located in these housings. Depending on the nature of the equipment involved, these components are printed circuit boards, storage disks, ventilators, loudspeakers, cooling units, pumps, gear units etc. The purpose of the chassis is to hold the individual components in a specific fixed position inside the device by mechanical means. Such a chassis generally consists of a frame with a number of partitions in which the components are fitted. The frame itself is attached to an external housing of the device concerned.

The use of parts made from rigid plastic for a chassis has also been disclosed for a long time now. As is the case with metal chassis, it is complicated and time-consuming to produce such a chassis, because attachment elements such as screws, rivets, tapes and other securing elements are required. Electromagnetic shielding facilities also have to be provided, in which plastic parts are covered with the conductive material and / or in which metal plates or foil are attached to the chassis. Chassis of this kind have too complicated a mechanical structure and it is too expensive to assemble them as well as to fit components.

In order to eliminate these disadvantages, the German utility model 9116755.8 describes a chassis for a device, such as a computer or an electronic measuring

instrument, that holds a number of components which form the device - for example printed circuit boards, storage disks, ventilators etc. A support unit made of a plastic such as rigid foam plastic is shaped to match the outer shapes of the components, with the components being held in the support unit essentially by positive locking without attachment elements being required and being enclosed by the support unit when they have been fitted in it. The support unit consists of a base section into which the components can be fitted when the chassis has been assembled and a top section that fits exactly onto the base section with the components that have been fitted into it. The top section can be removed or swivelled upwards to permit access to the larger components fitted in the base section. The support unit has ventilation ducts that are moulded into the plastic, while a ventilator is located in one ventilation duct in such a way that the flow of air produced by the ventilator is directed over components that need to be cooled. The chassis can also be configured in such a way that there are recesses at different levels, so that components can be located above each other. The chassis is made from a plastic that has a density of approximately 60 to 80 grams / litre. It has proved to be very advantageous to choose expanded polypropylene as the plastic for this purpose. Polypropylene is a lightweight material, is easy to mould into different shapes, absorbs impact, is elastic, has inherent resilient properties, is deformable and compliant as well, although it is very dimensionally stable all the same. Polypropylene is also resistant to temperature fluctuations and chemicals. It can be recycled completely and is therefore very advantageous from the environmental point of view. Materials such as polyurethane and polyethylene as well as similar plastics can, however, be used for the chassis as well. The above-mentioned chassis does, however, always need a housing made of metal or of a metallised rigid plastic. It has proved to be advantageous here if the chassis is enclosed by a metal housing that is open at its front and back ends, so that the chassis can be inserted into the housing through one of these openings. Front and

back shielding plates - produced typically from metal - cover the front and back surfaces of such a chassis.

The German utility model 29 704 237.8 also discloses a solution that consists of a chassis or component holder of the kind outlined above that is designed to permit incorporation in existing drawers etc. of laboratory, office, workshop, home or similar furniture, with the chassis or component holder forming an integral functional unit with the existing drawer, for example of a desk.

This housing for a device consists of a plastic (rigid foam plastic in particular) chassis or holder for accommodating the components of the device in question and a drawer (made of metal or lined with a metal layer, a metal plate or a metal foil) from a piece of furniture such as a desk or a cupboard or a section of a cupboard, where the (foam) plastic chassis is provided with elastic projections which act as holding/clamping devices with spaces that form adjustable and/or controllable ventilation ducts in connection with the metal case etc., these ducts creating an easily adaptable ventilation system for the individual components by means of plastic parts that can be placed or pushed into position or can be relocated as required. As a result of this, it is possible to house, for example, computers, measuring instruments, laboratory equipment, multimedia equipment etc. in the drawer of a desk or a laboratory table or in a drawer of a different piece of furniture, where the drawer in question and the plastic chassis form an integral functional unit and thus the actual housing for the device with a ventilation system.

The computer that is for example installed in a drawer in this way can be fitted highly effectively and works excellently due to the special design of the plastic chassis, without it being necessary to include the additional metal housing or metallised plastic housing that is otherwise always required for such a device

It has become apparent in the meantime that although these special solutions have the advantages indicated above, they are either unsuitable, too expensive or too inflexible for devices that are designed to be installed where they are visible and involve complicated operations when they have to be adapted to their environment, particularly as regards their external design.

The object of the invention is to create a simply produced housing for electronic devices with a chassis or component holder of the kind outlined above which is easy for people who are not experts to change, the external design of which is simple to change or adapt to the environment, which is designed to be light and to require a minimum of space in transport and storage and which nevertheless satisfies all the requirements of the relevant electrical shielding standards and specifications, such as Cisp. 22.2. Class B, 30 MHz - 1 GHz, in every respect

The main features of the solution proposed by the invention are outlined in the body of claims 1 and 2.

Further variations on the solution to the problem are outlined in claims 3 to 19.

Some of the additional advantages of the present invention are as follows:

The number of parts that form the actual housing for a device has been reduced to one. The requirements on production tolerances are less demanding than in the case of a state-of-the-art housing and chassis made from metal or rigid plastic, where parts which are to be assembled have to be manufactured with great precision to make sure it is possible to fit the different parts together exactly. The components can now be fitted into the chassis easily in the course of the production process and are clamped in position there securely without additional

attachment materials. The chassis is in turn very easy to fit into a folded sleeve or a folded housing produced from a single piece or a foldable blank made of a laminate, paper board, corrugated board or a similar material with appropriate openings. This is done simply by folding and locking the side panels, base and lid into position.

- The weight level has been reduced considerably by comparison with the previously disclosed designs;
- Very effective particle shielding, electrical shielding and a low radiation level, which satisfy the most demanding requirements made at the present time in accordance with specification Cispr. 22.2. Class B, 30 MHz - 1 GHz and also prevent electrostatic discharging and charging very efficiently, are achieved by the application of a metal layer / foil or the use of metal braiding / fabric. The components are cooled very effectively by means of internal ventilation ducts and appropriate openings in the housing or sleeve;
- The surfaces of the housing are shielded and contact between them is established by the creation of a labyrinth that forms a Faraday cage by giving the internal material layer a high level of surface conductivity and by choosing a special geometric configuration for the surface overlaps at the cut edge and/or folding points. Measurements have shown excellent results;
- The properties of the housing and chassis material mean that the components are protected against impact. In view of the impact-absorbent features of the chassis and the housing, the impact protection requirements on the packaging used for the device during transport are lower. Packaging material and transport volume are also reduced considerably as a result;

- Changing the housing and its external design is as straightforward, versatile and simple an operation as the assembly operation. It has become easy to provide a wide range of possible designs, to carry out maintenance work and to change the external design of the devices simply and inexpensively.

It should be emphasised here that the object of the invention is not limited to electronic equipment or precision instruments like computers or measuring instruments; it can instead be used for all kinds of equipment.

Further features of the invention are outlined and shown in the following description and the drawings.

The invention is now explained in greater detail with reference to the embodiments illustrated in the drawings. The reference numbers and terms given in the list of reference numbers at the end of this text are used in the description, the claims and the drawings to denote the same parts.

The drawings illustrate the following:

Fig. 1 is a flat blank for a folded box, a housing / sleeve for a device;

Fig 1A shows details of a projection for establishing the necessary contacts;

Fig 2 provides a detailed view of a box / an opened, folded housing for a device, showing the special plastic chassis and certain parts and/or components in perspective view;

Fig. 3 shows a device with the side panels folded down;

- Fig. 4 shows a completely assembled device before the folded box is closed;
- Fig. 5 shows a version of the folding configuration used to produce an electrostatic labyrinth and to give the housing for a device the necessary static properties and strength;
- Fig. 5A shows details of the folded projection;
- Fig 6 shows the electrical labyrinth and contacting system;
- Fig. 7 shows the housing / printed circuit board contacting configuration and ground connection and
- Figs. 8A-H show a sequence of folding operations (including coverage of the outside edge) for the production of a housing for a device.

The following comments need to be made before a detailed description is given about the figures:

The housing for an electrical or electronic device that is described here consists of a folded box made from paper board, laminate material, composite material or a material with similar properties. The paper board, composite material or laminate is provided with a material that has low-impedance surface conductivity properties in order to achieve the necessary shielding in accordance with the Faraday cage principle. Such a material can, for example, be a metal foil, a metal fabric or a metal net, but it can also be a thin metal layer that is applied directly. The box itself or the substrate for the material with low-impedance surface

conductivity properties can, for example, be paper board, corrugated board, a thick film, fabric, leather or also thermoplastics or thermoset plastics, such as resin-glass fibre material. The basic geometric shape of the housing is determined essentially by the chassis or component holder inside it as well as by specific requirements on the device. A blank is first of all produced for a folded box / a housing for a device from the laminate or composite material. The cube shape is achieved by erecting the blank in a series of folding operations. The folding configuration used makes it possible to combine fully effective contact surfaces with fully effective shielding. The geometric design of the overlap formed at the cut areas along an edge plays an important role here.

The mechanical functions of the housing and the device as a whole are achieved by using chassis or component holders that are made from foam plastic - as has already been described in detail in the introduction - in connection with the folded box or sleeve that is described in Figs. 1 to 8A - H. This makes sure that all the stability and static properties required by the device are achieved, while the cooling concept involving ventilation ducts is implemented fully effectively.

When a material that conducts electricity and is permeable to air is used, such as a net, a metal fabric or a fabric incorporating metal threads or particles, large openings provided to ventilate and cool the device can be covered up, thus guaranteeing protection against accidental contacts and creating a complete Faraday cage (the shielding remains viable). The mechanical functions of the housing and the device are achieved by using a chassis or component holder for the devices made from rigid foam plastic in connection with the folded box outlined above. This enables the stability and static properties required by the device to be achieved in combination with a fully effective cooling concept based on the ventilation ducts provided in the chassis and the openings provided in the box.

The complete device and the component holder and chassis are assembled together with the folded box by a sequence of folding operations. Since the folded box is made from paper board, laminate or a similar material, it is also simple to replace it by a new or different one if necessary. With the help of the design of the external surface, a device equipped in this way can be adapted to practically any environment without any difficulty and at low cost. It is in addition very easy to store the individual parts, because the box can be stored flat when it is still in the form of an unfolded blank, while the plastic chassis is also very simple to store and transport either with or without components. The chassis, the components and the box itself can therefore be assembled into a complete device not just during a production operation but also when the dealer or end-user receives them. No special tools or skills are required. The closure between the top section and the bottom section (i.e. the lid and the base) can be provided at the open edges by means of a Velcro fastener or a zip fastener (also in a metallised form to improve shielding) or by means of press fasteners or similar alternatives.

Fig. 1 shows a blank for a folded box (the housing for a device) that is mass-produced by being cut out of webs of material.

The flat blank for the housing for a device (folded box 1) has a base (bottom section) 2, a lid (top section) 3, side panels 4, 4' for the bottom and top sections, back panels 5 for the bottom and top sections, a front panel 6 and a projection 7. The projection 7 is always metallised on both sides as is shown in Fig. 1A, in order to guarantee perfect contact between the low-impedance metal surfaces when the blank is folded and thus to make sure that the Faraday cage works fully effectively. The folded box 1 is made, for example, from a laminate or a composite material that is provided on one side with a layer 9 consisting of a

metal foil, a metal net or a metal fabric. Paper board, corrugated board, leather, plastic etc. are other suitable materials for the actual substrate for the low-impedance layer 9. The required design can either be printed onto the outside surface of the substrate 10 (the folded box 1 for the device) or it can be produced by applying an appropriately designed film 11 as shown in Fig. 4. The blank shown in Fig. 1 also has openings 12 to allow air in, openings 13 to allow air out, openings 13 for the drives and openings 14 for the plug connector strip.

The dashed folding lines and edges 8 indicate the places where folds have to be made in accordance with the sequence of folding operations illustrated in Figs. 8A - H, with the help of which the assembly of the housing for a device and the sequence of folding operations needed to do this are described in detail.

Fig. 2 is a detailed illustration of an erected and open housing for a device with an exploded view of part of the plastic chassis and some of the components. The housing for a device itself consists of a bottom section (base) 2 and a top section (lid) 3, which have already been erected from the blank shown in Fig. 1. The side panels 4, the back panels 5, the front panel 6, the openings 13 to allow air out, the openings 15 for the plug connector strips and the printed circuit board 16 (with components) can also be seen clearly in this figure. The large components 20, such as drives, mains supply units and ventilators, which are held in the bottom section 17 of the chassis (which cannot be seen in this figure) are also clearly visible here. The top section 18 of the chassis with the retaining element 19 for the large components 20 that can be swivelled open is put on top to hold the components in position and then the housing for the device is closed by putting the lid (top section) 3 down.

When the housing for the device is closed, this also has the effect of establishing contact between the individual metallised surfaces, such as via the projections 7

shown in Figs. 1 and 1A in a Faraday cage. As has already been explained, the device can be closed completely - for example to be dust-tight - at its open edges with appropriate zip fasteners, Velcro fasteners or press fasteners or by means of appropriately applied screws.

Fig. 3 shows the housing for a device in the form of a folded box with the lid 3 in its completely erected form, with the front panel 6 and the side panels 4 of the bottom section (base) 2 folded down and with a component holder or chassis positioned on it that consists of the bottom section 17 of the chassis, the top section 18 of the chassis, the printed circuit board 16 and fitted components. This shows that it is extremely easy to fit the chassis and the components into such a folded housing, as all that needs to be done after the above parts have been put into position is to fold the side panels 4 up and close the lid 3.

Fig. 4 shows the device that has been assembled completely in this way and the folded box 1 before the lid (top section 3) is closed. It is still easy to get to the inside of the device even when this stage has been reached, so that it is simple and straightforward to handle, e.g. for maintenance purposes, for testing at the end of the production process or for customer service assignments. Accessibility is increased considerably by the fact that the box can be folded open.

Fig. 5 shows the folded box 1 after it has been erected but before it has been closed. The projections 7 that reliably establish the contacts between the low-impedance metal surfaces and provide dependable internal and external shielding inside the device when the lid 3 is closed are clearly visible again in this figure. The contact between the projections 7 on the side panels 4 and the back panel 5 of the bottom section 2 and the projections 7 of the side panels 4 and the back panel 5 of the top section 3 is made extremely reliable in particular by the top that, for example, the side panels 4 of both the bottom section 2 and the fact

section 3 that are folded inwards try constantly to return to their flat initial position due to the forces caused by the folding process, so that they press hard against each other and thus establish excellent contacts.

Figures 5A and 5B show details of the folding configuration used at the front, left-hand corner of the lid 3. Folding the side panels 4 and the back panel 5 together has the effect not only of creating the electrical labyrinth for shielding purposes but also of achieving the necessary static properties for the whole of the housing (folded box) 1. This folding configuration is shown again in detail in the folding operations 1 to 4 illustrated in Figures 8B - E, so these individual folding operations are not described any further here. Fig. 6 shows the excellent contacts between the metallised layer 9, the surface of the lid 3 and the base 2 that have already been described. It can be seen very clearly here that the projections 7 both on the side panels 4, 4' of the lid 3 and on the side panels 4 of the base 2 establish an excellent electrical connection with each other. As has already been explained, this connection is enhanced by the fact the metallised projections 7 are pressed against each other because the side panels 4 constantly try to return to their initial state before the folding process began. Fig. 7 shows a detail of the contact established between the printed circuit board 16 and other components 20 and/or plug sockets and plug connector strips with the metallised surface 9 of the substrate 10 of the folded box. It is, for example, possible to establish the earth connection by screwing in an earth screw 22 and/or by elastic force as is shown by the earth contact 21.

Figures 8A - H show the sequence of folding operations needed to produce a folded box 1. Fig. 8A starts by showing the flat blank as illustrated in Fig. 1. The first folding operation as shown in Fig. 8B is to fold the divided internal side panels 4' of the lid 3 upwards. In the second folding operation as shown in Fig. 8C, the back panel 5 and the front panel 6 are folded upwards, as a result of

which a box-like structure is already in the process of being formed together with the divided internal side panels 4'. The base 2 that has not yet been folded and is pointing backwards is located inseparably on the bottom (which is shown on the top in this figure) of the front panel 6. The external side panels 4 of the lid 3 are now folded upwards as well in the third folding operation in accordance with Fig. 8D. These side panels 4 are then folded downwards inside the box in the fourth folding operation shown in Fig. 8E. The lid (top section) 3 is already in its final state now. The fifth folding operation is shown in Fig. 8F and involves folding the side panels 4 of the base 2 upwards through 90° . The back panel 5 of the base 2 is then folded upwards through 90° as is shown in Fig 8G. The side panels 4, the front panel 5 and the back panel 6 are folded upwards either before or after the chassis has been fitted, depending either on the requirements of the production process in each individual case or on the repair requirements. Fig. 8H is a front view of the complete folded box 1 as the closed housing for a device.

List of the reference numbers

1	Folded box
2	Base or bottom section
3	Lid or top section
4	Side panels for the bottom and top sections
4'	Internal side panels of the lid
5	Back panels
6	Front panel
7	Projection
8	Folding lines or edges
9	Low-impedance layer that conducts electricity
10	Substrate
11	Film with the required design
12	Openings to allow air in
13	Openings to allow air out
14	Openings for drives
15	Openings for plug connector strips
16	Printed circuit board with components
17	Bottom section of the chassis
18	Top section of the chassis
19	Retaining element (for large components)
20	Large components (drives, mains supply units, ventilators etc.)
21	Earth contact
22	Earth screw

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CLAIMS

1. Equipment housing for a plastic chassis or for a component carrier, specifically made of expanded polypropylene, electrical, electronic, precision or mechanical components for electrical, electronic or precision equipment, wherein the equipment housing, as a folding box (1) consists of a base or substrate (10) made from composite material or a laminate, corrugated cardboard or cardboard, and the base (10) on the internal housing side, has a continuous electrically conductive, low-impedance surface or conductive, low impedance layer (9), characterised in that the flat blank for the folding box (1) has all the necessary openings (12 - 15) compatible in use with an equipped chassis or equipped component carrier (17, 18) and is designed to be folded into a folding box (1) with an internal Faraday shield.
2. Equipment housing according to claim 1, characterised in that the folding box (1) consists of a bottom section or base (2) and a lid or top section (3) that are hinged inseparably to each other along one edge, and in that the conductive layer (9) has a strip shaped cover (7) on the side panels (4) and on the front panels (6) of the base (2), which serves for the bonding of the conductive surface of the lid (3) and of the base (2) when in the folded state.
3. Equipment with a housing in the form of a folding box (1) according to claim 1 or 2, and a plastic chassis or component carrier, specifically made of expanded polypropylene, for electrical, electronic, precision or mechanical components for electrical, electronic or precision equipment such as, for example, personal computers or laboratory equipment, characterised in that the folding box (1) and the chassis or component

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carrier (17, 18) represent an integral electrical unit providing protection against irradiation and radiation emission, as well as a static mechanical unit.

- 5 4. Equipment housing or equipment according to one of claims 1 to 3,
— characterised in that the external faces of the folding box (1) are partially or
fully connected with designed film (11).
- 10 5. Equipment housing or equipment according to one of claims 1 to 4,
characterised in that the folded box (1) made of plastic, foil, material,
cardboard, artificial leather, which is provided with material of high surface
conductivity on the one side of the blank for the shielding or bonding of the
internal surface, forms an internal Faraday shield when in the folded state.
- 15 6. Equipment housing or equipment according to one of claims 1 to 5,
characterised in that the Faraday shield is produced by the application of
metal fabrics, metal nets, metal threads, metal foils, metal layers or layers
with metal content to the inner sides and surfaces of the folded box (1) by
folding technology and strip-shaped covers (7) for the bonding of the
20 metallic inner sides, faces and surfaces.
- 25 7. Equipment according to one of claims 3 to 6,
characterised in that the two side panels (4) of the folded box (1) are
provided in triple form, the back panel (5) in double form and the front panel
(6) in single form in the folded final state.
- 30 8. Equipment according to claims 3 to 6,
characterised in that the inner side panels (4') of the lid (3) consist of two
foldable sections.
9. Equipment according to one of claims 3 to 8,
characterised in that the openings (12-15) for admission of air, exit of air,

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drives, connector strips or the like are covered in an electrically conductive manner by materials containing metal fibres and/or metal particles.

10. Equipment according to one of claims 3 to 9,

— characterised in that the side panels (4) and the back panels (5) are designed at their abutting edges to be open and to swing up and down.

11. Equipment according to one of claims 3 to 10,

characterised in that one panel of the lid (3) forms the back panel (5) and the other panel forms the front panel (6) of the equipment or the folding box (1) and

in that the lid (3) is coupled to the base (2) in a raisable and lowerable or hinged manner.

12. Equipment according to one of claims 3 to 11,

characterised in that the back panel (5) of the housing is locked and bonded via an existing connector strip or earthed large components to the chassis (17, 18) or an earthed printed circuit board (16) for the components by at least one earth contact (21) designed as a snap-in or snap-on contact or one earth screw (22).

13. Equipment according to one of claims 3 to 12,

characterised in that the low-impedance conductive surface or layer (9) of the base (10) projects beyond the edges onto the opposite surface as a strip-shaped cover (7) at least at the free upper edges of the side panels (4) and the back panels (5).

14. Equipment according to one of claims 3 to 13,

characterised in that at least covers (7) of the side panels (4) of the lid (3)

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and of the base (2) have a splayed design to rest directly against one another, to press against one another and bond with one other.

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— 15. Equipment according to one of claims 3 to 14,
characterised in that at least the side panels (4) and the back panel (5) of
the base (2) are designed so that they can be swivelled or folded down.

10 16. Equipment according to one of claims 3 or 15,
characterised in that open equipment edges of the lid (3) and the base (2)
are closed together by means of Velcro fasteners, zip fasteners or press
fasteners that are metallised if necessary.