

ELECTRONIC DEVICE**TECHNICAL FIELD**

[0001] The described embodiments relate generally to small form factor electronic devices. More particularly, providing grounding support for a connector is described.

Description of the Related Art

[0002] The outward appearance of a small form factor electronic device, including its design and its heft can be important factors in determining a user's overall appreciation of the product. For example, the outward appearance and perceived quality of the device functionality can contribute to the overall impression that the user has of the small form factor electronic device. At the same time, the assembly of the small form factor electronic device is also an important consideration as a durable assembly helps to extend the overall life of the small form factor electronic device thereby increasing its value to the user.

[0003] One design challenge associated with the small form factor electronic device is the design of the enclosures used to house the various internal components. This design challenge generally arises from a number conflicting design goals that includes the desirability of making the enclosure lighter and thinner, the desirability of making the enclosure stronger and making the enclosure more esthetically pleasing. The lighter enclosures, which typically use thinner plastic structures and fewer fasteners, tend to be more flexible and therefore they have a greater propensity to buckle and bow when used while the stronger and more rigid enclosures, which typically use thicker plastic structures and more fasteners, tend to be thicker and carry more weight. Unfortunately, increased weight can lead to user dissatisfaction, and bowing can damage the internal parts.

[0004] The shape of the housing can also be such that the housing easily fits into a user's hand. This shape can be challenging when attempting to provide openings used to accommodate input/output devices such as connectors, audio ports, etc.

[0005] Therefore providing suitable openings in a highly curved housing used to support a small form factor electronic device is desirable.

SUMMARY OF THE DESCRIBED EMBODIMENTS

[0006] A method for heat sealing an electrical connector assembly is described. In the embodiment, the electrical connector assembly includes a plurality of electrical contacts each having a flat pad portion and an upraised portion in the form of a dimple, at least one window bracket arranged to engage a corresponding latch on a plug when the plug is inserted and engaged with the electrical connector assembly. The method can be carried out by performing at least the following operations. Providing the connector assembly in component accessible state, providing sealing tape, the sealing tape comprising a thin film impregnated with a heat sensitive adhesive, overlaying the housing and the flat pad portion of at least some of the electrical contacts with the sealing tape leaving at least some of the dimples substantially exposed, applying an amount of heat to the sealing tape, the amount of heat sufficient to liquefy the heat sensitive adhesive such that the liquefied adhesive flows over a surface of the housing and the plurality of electrical contacts, wherein the dimples remain exposed and sealing the electrical contact assembly by allowing the liquefied adhesive to cure.

[0007] An electrical connector assembly includes at least a plurality of electrical contacts each having a flat pad portion and an upraised portion in the form of a dimple, wherein at least one dimple is spring activated, the spring activated dimple forming an EMI ground tab and a metal housing, the metal housing laser welded to bracket using at least one exposed dimple as a laser target.

[0008] A moisture sealed electrical connector assembly includes a plurality of electrical contacts exposed to an external environment where each of the plurality of electrical contacts has a flat pad portion and an upraised portion in the form of a dimple and at least one dimple is spring activated forming an EMI ground tab. The electrical connector assembly also includes a bracket arranged to engage an associated latch on a connector plug when the connector plug is inserted into and engages the electrical connector assembly. The electrical connector assembly is heat sealed using sealing tape overlaying the housing, the flat pad portion of at least some of the electrical contacts and at least a portion of the dimples, leaving an upper part of the dimples remains exposed.

[0009] In one aspect, a metal housing is laser welded to the bracket using at least one exposed dimple as a laser target. In this way, the sealing tape prevents moisture passing from the external environment via the electrical contacts to the interior of the device housing thereby protecting the operational components from moisture related contamination.

[0010] A method of preventing moisture intrusion from an external environment into an interior of an electronic device having housing with an opening to the external environment is performed by carrying out the following operations. Providing a heat sealed electrical connector assembly. In the described embodiment, the heat sealed electrical connector assembly includes a plurality of electrical contacts at least a portion of which are exposed to the external environment where each of the electrical contacts are sealed to prevent the transport of moisture from the external environment to the interior of the electronic device. Placing the heat sealed electrical connector assembly within the opening and securing the heat sealed electrical connector assembly to the opening. In this way, the heat sealed electrical connector assembly substantially prevents moisture from passing from the exterior environment to the interior of the electronic device.

[0011] In one embodiment, a multi-pin connector assembly is described. The multi-pin connector assembly is arranged to facilitate an electrical connection between an electronic device and an external circuit. The multi-pin connector assembly includes at least an electrically insulating enclosure having a size and shape arranged to mechanically engage a connector plug in an engaged state, the connector plug having an electrically conductive body. In the described embodiment, the electrically insulating enclosure includes at least a top portion having at least two leaf type contacts arranged to provide electrical connections to corresponding ground tabs on the connector plug body in the engaged state, and a bottom portion having at least two ground contacts formed of highly conductive material each mechanically coupled to a spring assembly. In the engaged state, the spring assembly applies a spring force F_{spring} to the at least two ground contacts causing the at least two ground contacts to make electrical contact with the connector plug body.

[0012] In another embodiment, a personal media device is described. The personal media device includes at least a housing having at least a highly curved

portion wherein the housing includes at least one opening suitably sized to accommodate a multi-pin connector and a multi-pin connector assembly at least a part of which is associated with the highly curved portion of the housing. In the described embodiment, the part of the multi-pin connector assembly associated with the highly curved portion of the housing includes at least a spring loaded, small form factor, electrical contact assembly arranged to provide EMI ground contact between the multi-pin connector assembly and a conductive shell of a connector plug when the connector plug is inserted into and engages the multi-pin connector assembly.

[0013] In yet another embodiment, a method of manufacturing an electronic device, is described. The method can be carried out by performing at least the following operations. Providing a housing having at least a highly curved portion, forming at least one opening in the highly curved portion of the housing suitably sized to accommodate a multi-pin connector, providing the multi-pin connector assembly, inserting the multi-pin connector assembly into the opening, and securing the multi-pin connector to highly curved portion of the housing. In the described embodiment, the multi-pin connector includes an electrically insulating enclosure having a size and shape arranged to mechanically engage a connector plug in an engaged state to form an electrical connection between internal circuits in the electronic device and an external circuit, the connector plug having an electrically conductive body for providing a ground. The enclosure, in turn, includes a top portion having at least two leaf type contacts arranged to provide electrical connections to corresponding ground tabs on the connector plug body in the engaged state, and a bottom portion having at least two ground contacts formed of highly conductive material each mechanically coupled to a spring assembly, wherein in the engaged state, the spring assembly applies a spring force F_{spring} to the at least two ground contacts causing the at least two ground contacts to make electrical contact with the connector plug body.

DISPLAY ASSEMBLY

[0014] Broadly speaking, the embodiments disclosed herein describe structural components well suited for use in consumer electronic devices, such as laptops, cell phones, netbook computers, portable media players and tablet computers. In particular, structural components are described that address strength, packaging and thermal issues associated with the design of a light-weight consumer electronic device

with a thin and compact housing and an associated thin-profile display. Methods for forming these structural components are also described.

[0015] In one embodiment, the consumer electronic device can be a portable electronic device with a thin-profile display assembly that is disposed within a housing with a thin-profile. The display assembly can include at least a protective cover layer, a display stack that includes a plurality of display components arranged in a plurality of interconnected layers, and a flat support chassis arranged to provide support for the display stack. In the described embodiment, the display stack can be positioned between the protective cover layer and the flat support chassis. The display stack can be configured to provide imaging services. In additional, the display stack can include sensors for detecting an interaction of an object with the display, such as a touch input made by a user's finger.

[0016] In a particular embodiment, the thin-profile display assembly can be configured for packaging within a thin-profile housing with regions of high-curvature near its edges resulting in thickness changes from the edges to the center of the housing. In some areas, the display assembly and its associated imaging services can extend into the regions of high-curvature near the housing edges. For instance, a portion of the display assembly can extend to near an edge of the housing. In a particular embodiment, to accommodate a reduction thickness in the high curvature areas and to help align the display assembly close to the edge of housing, material can be removed from the flat support chassis.

[0017] As an example, to accommodate thickness changes in the housing near its edges and to help to align the display assembly, the flat support chassis can include chamfered edges. The chamfer angle can depend on the curvature of the enclosure and a shape of the support structure proximate to the flat support chassis. In one embodiment, the display assembly can be surrounded by a first frame arranged around a perimeter of and coupled to the housing. The frame can be used to provide a surface to which the protective cover layer of the display assembly is sealed. The first frame can include a hollowed out portion into which the flat support chassis and portions of the display stack extend. Chamfer parameters, such as the chamfer angle, can be selected to be compatible with the shape of the hollowed out portion into which the display assembly extends.

[0018] In another embodiment, a second frame can be coupled to the housing and disposed below the flat support chassis. The second frame can be formed from a thermally conductive material, such as a metal. The second frame can be thermally linked to one or more locations of the display assembly. The second frame can be configured to dissipate thermal energy away from the locations where it is thermally linked to the displayed assembly. The second frame can also be used to provide structural support to the display assembly. Towards this end, the second frame can be coupled to the flat support chassis. For instance, a bonding agent, such as an adhesive tape, can be used to mechanically couple the frame to the flat support chassis at a number of locations. If the bonding agent is thermally conductive, then mechanical support and thermal relief can be provided via the coupling between the second frame and the flat support chassis. The structural support provided by the frame to the display assembly may allow the flat support chassis to be thinned.

[0019] Other apparatuses, methods, features and advantages of the described embodiments will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is target that all such additional apparatuses, methods, features and advantages be included within this description be within the scope of and protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The described embodiments and the advantages thereof can best be understood by reference to the following description taken in conjunction with the accompanying drawings.

[0021] Figs. 1 – 2 are perspective diagrams showing various views of fully assembled personal media device in accordance with an embodiment of the invention.

[0022] Fig. 3 is a side view of personal media device in accordance with the described embodiments.

[0023] Fig. 4 shows a top view of interior of housing showing G-frame in more detail.

[0024] Fig. 5 shows an enlarged view of a portion of housing shown in Fig. 2 viewed in a head on perspective showing connector assembly in accordance with the described embodiments.

[0025] Fig. 6 shows a cross sectional view of connector assembly showing the relationship of connector assembly and the spline shape of housing.

5 [0026] Fig. 7 shows a cross sectional view of connector assembly showing the relationship of connector assembly and the spline shape of housing with inserted connector plug.

[0027] Fig. 8 shows interior view of connector assembly showing contact pads associated with spring activated dimples.

[0028] Fig. 9A-9C shows a process for heat sealing a connector assembly in accordance with the described embodiments.

10 [0029] Fig. 10 shows a heat sealed connector assembly.

[0030] Fig. 11 shows a flowchart detailing process for manufacturing an electronic device in accordance with the described embodiments.

[0031] Fig. 12A shows a perspective view of a display assembly, a top glass, a glass frame and housing in accordance with the described embodiments.

15 [0032] Fig. 12B shows a perspective view of a display assembly, a cover glass, a glass frame and housing and a secondary frame in accordance with the described embodiments.

[0033] Figs. 13A-C show perspective and side views of a secondary support frame that can provide mechanical support and thermal relief for a display assembly in accordance with the described embodiments.

[0034] Fig. 14A shows a cross sectional view of a display assembly including a flat support chassis in accordance with the described embodiments.

25 [0035] Fig. 14B shows a cross sectional view of a display assembly showing the relationship between the display assembly, it surrounding support structure and the curvature of the housing in accordance with the described embodiments.

[0036] Fig. 14C shows a cross sectional view of a display assembly coupled to a glass frame and a secondary support frame in accordance with the described embodiments.

30 [0037] Fig. 15 is a flow chart of a method of generating a support chassis for a display assembly in accordance with the described embodiments.

[0038] Fig. 16 is a block diagram of an arrangement of functional modules utilized by a portable media device.

[0039] Fig. 17 is a block diagram of a media player suitable for use with the described embodiments.

DETAILED DESCRIPTION OF REPRESENTATIVE EMBODIMENTS

[0040] In the following detailed description, numerous specific details are set forth to provide a thorough understanding of the concepts underlying the described embodiments. It will be apparent, however, to one skilled in the art that the described embodiments can be practiced without some or all of these specific details. In other instances, well known process steps have not been described in detail in order to avoid unnecessarily obscuring the underlying concepts.

[0041] Aspects of the described embodiments relate to a small form factor electronic product. For the remainder of this discussion, the small form factor electronic device will be described in terms of a personal media device. The personal media device can include housing suitable for enclosing and supporting various operational components. The housing can support various input/output mechanisms such as volume switches, power buttons, data and power connectors, audio jacks and the like. The housing can include openings to accommodate the input/output mechanisms. The locations at which the input/output mechanisms are placed can be selected to enhance the usability of the interface under conditions for which the device is intended to operate. For instance, for a device intended to be operated with a single hand, the input mechanisms, such as an audio control switch, can be placed at a location that are easily finger operated while the device is held in the palm of the hand. Other output mechanisms, such as an audio jack, can be placed at locations that do not interfere with holding the device, such as on a top edge of the device.

[0042] Device components that connect to and allow the personal media device to operate for its intended functions can be packaged within the enclosure. Some flexibility can be afforded in regards to the locations of the internal device components as long as sufficient space for needed connectors between components is available. Also, approaches, such as custom-shaped printed circuit boards (PCBs) or batteries can be employed to allow available internal spaces to be efficiently utilized. A connector assembly used to accommodate the connector port can be widely varied. For example, the connector assembly can take the form of a data/power connector (such as a standard 30 pin type connector). The connector assembly can also be

associated with an output device such as an audio jack having an audio jack barrel with a size and shape in accordance with an audio post. The audio post can be inserted into the audio jack barrel. In this way electrical contacts on the audio post engage corresponding contact pads on an interior surface of the audio jack barrel allowing electrical signals to pass between an external circuit (such as headphones) and the personal media device. Typically, when the audio post is inserted into the audio jack barrel, the acoustic speakers are disabled such that the insertion of the audio jack into the audio jack barrel does not interfere with the outputting of audible sound.

10 [0043] These and other embodiments are discussed below with reference to Figs. 1 - 12. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes only and should not be construed as limiting.

15 [0044] Figs. 1 - 2 are perspective diagrams showing various views of fully assembled personal media device 100 in accordance with an embodiment of the invention. Personal media device 100 can be sized for one-handed operation and placement into small areas such as a pocket, i.e., personal media device 100 can be a handheld pocket sized electronic device. By way of example, personal media device 100 can correspond to a computer, media device, telecommunication device and/or the like. Personal media device 100 is capable of processing data and more particularly media such as audio. Personal media device 100 can generally correspond to a music player, game player, video player, personal digital assistant (PDA), and/or the like. With regards to being handheld, personal media device 100 can be operated solely by the user's hand(s), i.e., no reference surface such as a desktop is needed. In some cases, the handheld device is sized for placement into a pocket of the user. By being pocket sized, the user does not have to directly carry the device and therefore the device can be taken almost anywhere the user travels (e.g., the user is not limited by carrying a large, bulky and heavy device).

25 [0045] Personal media device 100 can be widely varied. In some embodiments, personal media device 100 can perform a single function (e.g., a device dedicated to playing and storing media) and, in other cases, the personal media device can perform multiple functions (e.g., a device that plays/stores media, receives/

transmits telephone calls/text messages/internet, and/or performs web browsing). Personal media device 100 is capable of communicating wirelessly (with or without the aid of a wireless enabling accessory system) and/or via wired pathways (e.g., using traditional electrical wires). In some embodiments, personal media device 100
5 can be extremely portable (e.g., small form factor, thin, low profile, lightweight). Personal media device 100 can even be sized for one-handed operation and placement into small areas such as a pocket, i.e., personal media device 100 can be a handheld pocket sized electronic device. Personal media device 100 can correspond to any of those electronic devices an iPod™, or an iPhone™ available by Apple Inc. of
10 Cupertino, California.

[0046] Personal media device 100 can include housing 102 configured to at least partially enclose any suitable number of components associated with personal media device 100. For example, housing 102 can enclose and support internally various electrical components (including integrated circuit chips and other circuitry)
15 to provide computing operations for the device. The integrated circuit chips and other circuitry can include a microprocessor, memory, a battery, a circuit board, I/O, various input/output (I/O) support circuitry and the like. Although not shown in this figure, housing 102 can define a cavity within which the components can be positioned and housing 102 also can physically support any suitable number of
20 mechanisms, within housing 102 or within openings through the surface of housing 102.

[0047] In addition to the above, housing 102 can also define at least in part the outward appearance of personal media device 100. That is, the shape and form of housing 102 can help define the overall shape and form of personal media device 100
25 or the contour of housing 102 can embody the outward physical appearance of personal media device 100. Any suitable shape can be used. In some embodiments, the size and shape of housing 102 can be dimensioned to fit comfortably within a user's hand. In some embodiments, the shape includes a slightly curved back surface and highly curved side surfaces. Housing 102 is integrally formed in such a way as to
30 constitute is a single complete unit. By being integrally formed, housing 102 has a seamless appearance unlike conventional housings that include two parts that are fastened together thereby forming a reveal, a seam there between. That is, unlike

conventional housings, housing 102 does not include any breaks thereby making it stronger and more aesthetically pleasing. Housing 102 can be formed of any number of materials including for example plastics, metals, ceramics and the like. In one embodiment, housing 102 can be formed of stainless steel in order to provide an aesthetic and appealing look and feel as well as provide structural integrity and support for all sub-assemblies installed therein. When metal, housing 102 can be formed using conventional collapsible core metal forming techniques well known to those skilled in the art.

[0048] Personal media device 100 also includes cover 106 that includes a planar outer surface. The outer surface can for example be flush with an edge of the housing wall that surrounds the edge of the cover. Cover 106 cooperates with housing 102 to enclose personal media device 100. Although cover 106 can be situated in a variety of ways relative to the housing, in the illustrated embodiment, cover 106 is disposed within and proximate the mouth of the cavity of housing 102. That is, cover 106 fits into an opening 108. In an alternate embodiment, cover 106 can be opaque and can include touch sensing mechanism that forms a touch pad. Cover 106 can be configured to define/carry the user interface of personal media device 100. Cover 106 can provide a viewing region for display assembly 104 used to display a graphical user interface (GUI) as well as other information to the user (e.g., text, objects, and graphics). Display assembly 104 can be assembled and contained within housing 102. Such user input events can be used for any number of purposes, such as resetting personal media device 100, selecting between display screens presented on display assembly 104, and so on. In one embodiment, cover 106 is a protective top layer of transparent or semitransparent material (clear) such that display assembly 104 is visible there-through. That is, cover 106 serves as a window for display assembly 104 (i.e., the transparent cover overlays the display screen). In one particular embodiment, cover 106 is formed from glass (e.g., cover glass), and more particularly highly polished glass. It should be appreciated, however, that other transparent materials such as clear plastic can be used.

[0049] The viewing region can be touch sensitive for receiving one or more touch inputs that help control various aspects of what is being displayed on the display screen. In some cases, the one or more inputs can be simultaneously received

(e.g., multi-touch). In these embodiments, a touch sensing layer (not shown) can be located below the cover glass 106. The touch sensing layer can for example be disposed between the cover glass 106 and the display assembly 104. In some cases, the touch sensing layer is applied to display assembly 104 while in other cases the touch sensing layer is applied to the cover glass 106. The touch sensing layer can for example be attached to the inner surface of the cover glass 106 (printed, deposited, laminated or otherwise bonded thereto). The touch sensing layer generally includes a plurality of sensors that are configured to activate as the finger touches the upper surface of the cover glass 106. In the simplest case, an electrical signal is produced each time the finger passes a sensor. The number of signals in a given time frame can indicate location, direction, speed and acceleration of the finger on the touch sensitive portion, i.e., the more signals, the more the user moved his or her finger. In most cases, the signals are monitored by an electronic interface that converts the number, combination and frequency of the signals into location, direction, and speed and acceleration information. This information can then be used by the personal media device 100 to perform the desired control function relative to display assembly 104.

[0050] Personal media device 100 can also include one or more switches including power switches, volume control switches, user input devices and the like. Power switch 110 can be configured to turn personal media device 100 on and off, whereas volume switches 112 is configured to modify the volume level produced by the personal media device 100. Personal media device 100 can also include one or more connectors for transferring data and/or power to and from personal media device 100. For example, opening 115 can accommodate audio jack 116 whereas opening 117 can accommodate data/power connector 118. Audio jack 116 allows audio information to be outputted from personal media device 100 by way of a wired connector whereas connector 118 allows data to be transmitted and received to and from a host device such as a general purpose computer (e.g., desktop computer, portable computer). Connector 118 can be used to upload or down load audio, video and other image data as well as operating systems, applications and the like to and from personal media device 100. For example, connector 118 can be used to download songs and play lists, audio books, photos, and the like into the storage

mechanism (memory) of personal media device 100. Connector 118 also allows power to be delivered to personal media device 100.

[0051] Portion 200 of personal media device 100 can include a number of communication features. For example, portion 200 can include at least first audio port 120 that can be used to output a first portion of audible sound generated by an audible sound generator assembly enclosed within housing 102. The audible sound generator assembly can take many forms. In the described embodiment, however, the audible sound generator assembly includes at least a diaphragm arranged to synchronously vibrate with audio signals provided by a processing unit included in personal media device 100. The audio signals can be provided by the processing unit decoding audio data files retained within personal media device 100. Enclosed within connector assembly 118, second audio port 122 can be used to output a remaining portion of the audible sound generated by the audible sound generator assembly. In this way, first audio port 120 and second audio port 122 can cooperatively output the audible sound generated by the audible sound generator assembly. By cooperative it is meant that when, for example, first audio port 120 is blocked or otherwise obstructed (by a finger, clothing, etc.), the placement of second audio port 122 substantially precludes the likelihood that second audio port 122 will also be blocked. Therefore, since first audio port 120 and second audio port 122 share an air path from the audible sound generator to the external environment, when one portion of the air path (that portion associated with first audio port 120, for example) is blocked or otherwise obstructed, at least some of the first portion of audible sound generated by the audible sound generator assembly can be passively re-directed to second audio port 122 thereby substantially preserving an overall perceived sound output level.

[0052] Fig. 3 shows a cross-sectional view of a portable electronic device 100 shown in Figs. 1 - 2. Housing 102 can enclose various internal device components such as those associated with the user interface that allow personal media device 100 to operate for its intended functions. For the purposes of discussion, the internal device components can be considered to be arranged in a number of stacked layers. For example, a display screen of the display assembly 104 can be located directly below the top glass 106. In one embodiment, the display screen and its associated display driver circuitry can be packaged together as part of the display assembly 104.

Below display assembly 104, device circuitry 130, such as a main logic board or circuitry associated with other components, and a battery 132, which provides power to personal media device 100, can be located.

5 [0053] Internal frame 140 can add to the overall stiffness of personal media device 100 by, for example, enhancing an ability to resist bending moments experienced by housing 102. Internal frame 140 can be formed of many strong and resilient materials. For example when internal frame 140 is formed of metal such as stainless steel, internal frame 140 can be referred to as M (etal)-frame 140. M-frame 140 can provide both structural support for personal media device 100 but also act to
10 aid in the transfer of heat generated by the various internal components to the external environment. M-frame 140 can be located below the display assembly 104 and above the device circuitry 130. In this way, M-frame 140 can provide support for various internal components as well as aid in transferring heat from internal components such as display assembly 104.

15 [0054] M-frame 140 can be used as an attachment point for other device components. For example, M-frame 140 can be attached to mounting surface, such as 134a and 134b, on housing 102 via fasteners or using a bonding agent. Then, other device components, such as display assembly 104 can be coupled to M-frame 140 rather than directly to housing 102. One advantage of coupling display assembly 104
20 to the housing via M-frame 140 is that display 140 can be somewhat isolated from bending moments associated with housing 102, i.e., bending moments generated on the housing can be dissipated into M-frame 140. Isolating the display assembly 104 from bending moments associated with housing 102 can prevent damage to display assembly 104, such as cracking, from occurring.

25 [0055] It should be noted that in some embodiments, personal media device 100 can include additional internal frames. For example, frame 150 can be affixed directly to housing 102 and generally may act to support top glass 106. In this regard, frame 150 can be referred to as G (lass)-frame 150. In order to support cover glass 106, G-frame 150 can include rim 152 having flange portion 154 where cover glass
30 106 is glued to rim 152 about flange 154, thus sealing the entire device. G-frame 150 can be made of an electrically non-conductive frame material, such as a glass filled plastic. One example glass-filled plastic suitable for use in G-frame 150 is KALIX™,

manufactured by Solvay Advanced Polymers of Alpharetta, GA. KALIX™ includes 50% glass-fiber reinforced high-performance nylon. One of ordinary skill in the art will recognize that there are many other potential frame materials that would be suitable for use with this embodiment, and the claims should not be construed as being limited to KALIX™ or any other glass-filled plastic unless expressly stated.

[0056] Fig. 4 shows a top view of interior of housing 102 showing G-frame 150 in more detail. Here, housing 102 is provided, which is made of an electrically conductive material. An example of an electrically conductive material suitable for use with this embodiment is stainless steel, although one of ordinary skill in the art will recognize that there are many other potential materials that would be suitable with this embodiment and the claims should not be construed as being limited to stainless steel unless expressly stated. G-Frame 150 is affixed to housing 102, and generally may act to support a front face (not pictured) of the device. The front face may be made of transparent material, such as glass, and may act to cover the device, yet permit a user to view through the cover to a display (not pictured) underneath. This display may also act as an input device. For example, the display may be one of many different types of touch screens. In order to support the cover, G-frame 150 may include rim 402 having flange portion 404. In one embodiment, the cover is glued to rim 402 about flange 404, thus sealing the entire device. Thus, rim 402 acts not only as a support for the cover but also as a junction area where the cover may be affixed to the frame.

[0057] Fig. 5 shows an enlarged view of portion 200 of housing 102 shown in Fig. 2 viewed head on. For the remainder of this discussion and without loss of generality, first audio port 120 will be referred to as housing port 202 and second audio port 120 as connector port 204. Housing port 202 can have a size and shape in keeping with the overall shape and appearance of housing 102. For example, side walls 206 of housing 102 can have a spline, or curved shape that facilitates a user holding personal media device 100 in a hand. Accordingly, housing port 202 can be shaped to more readily blend in with the shape of sidewalls 206. Housing port 202 can be located distance “d” from rear surface 208 of housing 102.

[0058] Fig. 6 shows a cross sectional view of connector assembly 118 showing the relationship of connector assembly 118 and the spline shape of housing 102. As

can be seen, due to the shape of housing 102, the portion of connector 118 has a limited depth of engagement with regards to housing 102. For example, top portion 602 can accommodate more of a connector plug than bottom portion 604. Due to this reduced amount of support, ground tabs on a connector plug cannot make an adequate electrical connection with ground contacts that would otherwise be available at bottom portion 604. Therefore, as shown in Fig. 7, in order to maintain at least four ground connections between connector plug 702 and connector assembly 118, at least two springs activated ground contacts 704 can be provided at bottom portion 604 of connector assembly 118. In the described embodiment, spring activated ground contacts can take the form of dimples 704 formed of highly conductive material along the lines of stainless steel, copper, and so forth. In addition to spring activated dimples 704, at two additional leaf type contacts 706 can be provided at top portion 602. In this way, at least four EMI ground tabs can be provided by connector assembly 118. In order to assure that overall contact resistance is minimized in spite of the reduced contact area presented by dimples 704, spring force F_{spring} can be in the range of about 150 grams or thereabout. Dimples 704 can protrude through a plastic body of connector assembly 118 and make contact with metal housing of plug 702 shown in Fig. 8.

[0059] Fig. 8 shows an interior head on view of connector assembly 118 showing contact pads 802 corresponding to dimples 704. Contact pads 802 make direct contact with the metal shell of plug 702.

[0060] In order to assure that moisture or other liquid contaminants are inhibited from migrating from the external environment to the interior of portable media device 100, connector assembly 118 can be sealed in a manner shown in Figs. 9A – 9C. Accordingly, prior to insertion into housing 102, connector assembly 118 can be separated into a number of constituent parts (Fig. 9A). For example, window brackets 902 can engage with associated latches on a plug when inserted into and engaged with connector assembly 118. Therefore, in the partially dis-assembled condition electrical contacts 904 are readily accessible. It should be noted that electrical contacts 904 can include a flat pad portion and an upraised portion, referred to as dimple 906. In order to seal connector assembly 118 against water intrusion, sealing tape 908 can be overlaid electrical contacts 904 and housing 910. Once properly placed, sealing tape

908 can be adhered to electrical contacts 904 and housing 910 thereby sealing connector assembly 118 from water intrusion (Fig. 9B). In one embodiment, sealing tape 908 can take the form a film impregnated with heat sensitive adhesive. Therefore, by applying an appropriate amount of heat, the heat sensitive adhesive can
5 liquefy and flow over the surface of housing 910 and electrical contacts 904. In one implementation, the heat process can take the form of a hot iron press operation having the result that sealing tape 908 adheres to both electrical contacts 904 and housing 910.

[0061] It should be noted, however, the dimples 906 can remain substantially
10 exposed since they poke through sealing tape 908. By leaving at least a portion of dimples 906 exposed, metal shell 912 can be slid over and welded to connector assembly 118 at the exposed portions of dimples 906 (Fig. 9C).

[0062] Fig. 10 shows a cross section of connector assembly 118 in accordance with the described embodiments. Assembly 118 shows weld locations 1002 through
15 sealing tape 908 and the relative position of top seal 1004 and bottom seal 1006 sealing both top portion 1008 and 1010, respectively, of connector assembly 118.

[0063] In one embodiment, manufacturing an electronic device in accordance with the described embodiments can be carried out by providing a housing having at least a highly curved portion, forming at least one opening in the highly curved
20 portion of the housing suitably sized to accommodate a multi-pin connector, providing the multi-pin connector assembly, inserting the multi-pin connector assembly into the opening; and securing the multi-pin connector to highly curved portion of the housing.

[0064] Fig. 11 shows a flowchart detailing process 1200 in accordance with the
25 described embodiments. Process 1200 can be performed by providing a connector assembly in a component accessible state. By component accessible state it is meant that the connector assembly is partially dis-assembled so as to provide access to specific components such as electrical contacts. At 1204, a sealing film is overlaid the electrical contacts and housing. The contacts having a flat pad portion in direct
30 contact with a surface of the housing of the connector assembly and an upraised dimple portion. In the described embodiment, the sealing film can take the form of tape impregnated with heat sensitive adhesive. It should be noted that the sealing tape

overlays and covers the flat pad portion of the electrical contact and a portion of the housing in proximity to the flat portion providing a first seal. Once the sealing tape is properly placed, the connector assembly undergoes a heating process at 1206 that exposes the sealing tape to sufficient heat to cause the heat sensitive adhesive to at least partially liquefy and attach sealing tape to both the flat portion of the electrical contact and the housing. At 1208, a metal shell is placed around the sealed connector assembly and is secured to the housing by laser welding using the exposed dimples as targets.

DISPLAY ASSEMBLY

10 [0065] The various aspects, embodiments, implementations or features of the described embodiments can be used separately or in any combination. Various aspects of the described embodiments can be implemented by software, hardware or a combination of hardware and software. The described embodiments can also be embodied as computer readable code on a non-transitory computer readable medium.

15 The computer readable medium is defined as any data storage device that can store data which can thereafter be read by a computer system. Examples of the computer readable medium include read-only memory, random-access memory, CD-ROMs, DVDs, magnetic tape, and optical data storage devices. The computer readable medium can also be distributed over network-coupled computer systems so that the computer readable code is stored and executed in a distributed fashion.

20 [0066] In one embodiment, described in more detail with respect to Figs. 12A-12C, the display assembly 104 can include a flat support chassis. The components associated with the display assembly 104, such as the display circuitry can be sandwiched between the flat support chassis and the cover glass 106. M-frame 140 can be coupled to a flat support chassis associated with the display assembly. As is described in more detail with respect to Fig. 13C, coupling the M-frame 140 to the flat support chassis can reduce bending loads to the display assembly and hence allow the thickness of the flat support chassis to be reduced.

25 [0067] It should be noted that in some embodiments, personal media device 100 can include additional internal frames. For example, frame 150 can be affixed directly to housing 102 and generally may act to support cover glass 106. In this regard, frame 150 can be referred to as G(lass)-frame 150. In order to support cover

glass 106, G-frame 150 can include rim 152 having flange portion 154 where cover glass 106 is glued to rim 152 about flange 154, thus sealing the entire device. G-frame 150 can be made of an electrically non-conductive frame material, such as a glass filled plastic. One example glass-filled plastic suitable for use in G-frame 150 is KALIX™, manufactured by Solvay Advanced Polymers of Alpharetta, GA. KALIX™ includes 50% glass-fiber reinforced high-performance nylon. One of ordinary skill in the art will recognize that there are many other potential frame materials that would be suitable for use with this embodiment, and the claims should not be construed as being limited to KALIX™ or any other glass-filled plastic unless expressly stated. An arrangement of the G-Frame 150, M-Frame 140, cover glass 106 and display assembly for one embodiment of a personal media device are described as follows with respect to Figs. 4A and 4B.

[0068] Fig. 12A shows a perspective view of a display assembly 104, a cover glass 106, a glass frame 150 and housing 102. The display assembly 104, which can comprise a number of stacked layers, can be mounted to the top glass (Additional details of the stacked layers of the display assembly are described in more detail with respect to Figs. 13A-13C.) The glass frame 150 can be designed to fit within an outer perimeter of the housing 102 and mounted to the housing in some manner, such as via a bonding agent(s) and/or the use of fasteners, such as a fastener inserted through attachment point 160. The glass frame 150 can be mounted to the housing such that a seal is formed between the housing and the glass frame 150. The seal can prevent environmental contaminants from reaching an interior of the housing 102 via the interface between the glass frame 150 and housing 102.

[0069] The glass frame 150 can include a rim 406. A bottom of the cover glass 106 can be mounted to the top of the rim of the glass frame 150. Thus, the glass frame 150 can provided structural support including resistance to bending to the cover glass 106. The cover glass 106 can be mounted to the glass frame 150 such as a seal is formed between the cover glass 106 and glass frame 150. The seal can provide a barrier that prevents external contaminants, such as moisture for entering into an interior of the housing 102. In this embodiment, when the cover glass 106 and glass frame 150 are mounted to one another and the glass frame 150 is mounted to the housing, the display assembly 106 can “hang” from the bottom of the cover glass 106.

As described with respect to Fig. 1, in an assembled position, the cover glass 106 can form the top face of a personal media device.

[0070] In various embodiments, the support functions of the glass frame 150 can be integrated into the housing 102. For instance, the housing 102 may include a rim that allows the cover glass 106 to be directly mounted to housing. This feature may allow or a portion of the glass frame to be eliminated. Thus, a separate housing 102 and glass frame 150 is provided for the purposes of illustration only.

[0071] Along the long sides of the housing, such as near attachment point 160, the display can be placed close to an edge of the housing 102. In these areas, as a result of the sloped sides, the thickness of the housing 102 decreases as the outer edge of the housing 102 and an outer edge of the cover glass 106 are approached. The decrease in thickness of the housing limits the space available for the glass frame 150 and the display assembly 104. In one embodiment, to allow the display assembly to extend close to the edge of the housing 102, the glass frame can be thinned and/or hollowed out. Further, material can be removed from the display assembly to allow it fit in the available space near the edges of the housing. These embodiments are described in more detail with respect to Figs. 13A-13C.

[0072] Fig. 12B shows a perspective view of a display assembly 104, a cover glass 106, the cover glass frame 150, the housing 102 and an M-frame 140. In one embodiment, the M-frame 140 can be disposed below the display assembly 104. The M-frame can be configured to provide thermal and/or structural support to various internal device components including the display assembly. During assembly, the M-frame 140 can be mounted to the glass frame and/or the housing 102. For example, the M-frame 140 can be attached to the housing 102 via a fastener, such as a screw, inserted through the attachment point 160. As another example, the M-frame 140 can be secured to the cover glass frame 150 where the cover glass frame is secured to the housing. In yet another example, the M-frame 140 can be secured to the housing 102 and then the cover glass frame 150 can be secured to the M-frame 140.

[0073] In various embodiments, the M-frame can be coupled to the display assembly 104 at a number of locations. A bonding agent selected for the coupling can be selected for thermal and/or mechanical properties. For instance, the M-frame can be used to conduct heat and hence provide thermal relief at different locations on the

bottom of the display assembly, such as locations where the display assembly tends to get hot. At these locations, a bonding agent can be used that is thermally conductive so that heat can flow into the M-frame and be conducted away from the local hot spot.

[0074] At other locations on the bottom of the display assembly, the M-frame can be used to provide structural support, such as to increase the display assembly's resistance to bending, i.e., structural stiffness. At these locations a bonding agent can be selected that is relatively thermally non-conductive such that a mechanical link is formed but the amount of thermal conduction through the bond is limited. At yet other locations, a bonding agent can be selected for both its mechanical and thermal properties such that structural support and thermal relief is provided. Using such a bonding agent, a bond that provides both structural support for the display assembly 104 and enables thermal conduction of heat into the m-frame 140 from the display assembly 104 can be formed. Further details of forming such bonds are described in more detail with respect to Figs. 13A-13C. Additional details of the M-frame, such as its shape, are described as follows with respect to Figs. 14A-14C.

[0075] Figs. 13A-C show perspective and side views of a secondary support frame that can provide mechanical support and thermal relief for a display assembly. As shown in Fig. 13A, in one embodiment, the M-frame 140 can be formed as a substantially flat sheet. The sheet can include a number of attachment points, such as 160, that allow the M-frame 140 to be coupled to the housing 102 and/or the glass frame 150 described above with respect to Fig. 12B. A fastener, such as a screw can be used with the attachment point. In other embodiments, a bonding agent, such as a pressure sensitive adhesive, can be used alone or in conjunction with other types of fasteners for securing the M-frame 140 to another structure, such as the housing 102. Besides attachment points that allow the M-frame 140 to be secured to other structures, the M-frame 140 can also include a number of attachment points (not shown) that allow other device components, such as a main logic board (not shown) to be attached to the M-frame.

[0076] In particular embodiments, as is illustrated in Fig. 13B, the M-frame 140a can include a number of apertures, such as apertures 170. In one embodiment, the apertures can be provided to reduce the weight of the M-frame 140. In addition, the apertures can be provided to provide a pathway for data and/or power connectors.

[0077] In particular embodiments, an M-frame, such as 140, does not have to be flat. In Fig. 13C, a profile of the M-frame as viewed along the side edge 172 is illustrated. Although, as shown in Fig. 13C, the profile can be flat, the profile can also be raised in different regions. For instance, the M-frame could be attached at one height to the housing and/or the glass frame and then extend upwards so that it can be bonded to a bottom of the display assembly. In other embodiments, the M-frame could be attached at a height greater than a bottom of the display assembly and then extend downwards to allow a bottom portion of the display assembly to be coupled to the M-frame.

10 [0078] With respect to the following figures, additional details of a display assembly including a display stack and a support chassis and their interface to the glass frame, M-frame and housing are described. In particular, details of the display assembly including the support chassis for the assembly are described with respect to Fig. 14A. An example of a display assembly's interface to the housing, glass frame and/or m-frame is described with respect to Figs. 14B and 14C. In more detail, as described above, with respect to Fig. 12A, in some regions where the display assembly is placed closed to an edge of the housing, the glass frame and the support chassis can be modified to account for the limited space imposed by the decreasing thickness of the housing. These modifications are discussed in more detail with respect to Fig. 14B.

[0079] Fig. 14A shows a cross sectional view of a display assembly 402 including a substantially flat support chassis 404. The display assembly 402 can include a display stack, such as 409 with various display layers 410. The display layers can be formed to provide different functions associated with the imaging services generated by the display assembly. For instance, for a liquid crystal display one layer can include the liquid crystals and another layer can include control circuitry associated with the liquid crystals. In another example, one layer can be associated with a light pipe configured to provide back-lighting for the display assembly 402.

30 [0080] Each of the display layers 410 in the display stack 409 can be bonded to one another. The bottom layer in the display stack 409 can be bonded to the display chassis 404 such that the display stack 409 is sandwiched between the display chassis

404 and the cover glass 106. The display chassis 404 as well as the other layers in the display stack 409 can be substantially flat. A protective cover material 403 can be placed over the sides of the display stack 409 and/or the display chassis 404 and bonded to a bottom of the display chassis 404 to protect the display stack 409 from contaminants.

[0081] The display chassis 404 can provide structural support for the display assembly 402. In particular, the display chassis 404 can provide structural stiffness and bending resistance. The bending resistance can prevent damage, such as cracking or de-bonding of the various layers in the display stack 409, resulting from an application of a bending moment to the display stack 409. The thickness of the display stack 409 can be sized to resist a certain amount of bending in accordance with desired operational performance objectives, such as drop test requirements.

[0082] Fig. 14B shows a cross sectional view of a display assembly showing the relationship between the display assembly, its surrounding support structure and the curvature of the housing. The figure is illustrative of a placement of a display assembly close to the edge of a top surface of personal media with a curved housing (e.g., near attachment point 160 in Fig. 12A.). The housing 102 forms an outer surface for the personal media device and a cover glass 150 frame can be inserted around an interior perimeter of the housing 102 and bonded or attached to the housing in some manner (see Fig. 12A -12B). An additional support structure, frame 140, is disposed below the support chassis 404. As described with respect to Fig. 12B, the M-frame 140 can be configured to provide thermal relief to the display assembly by conducting away excess heat. As is described in more detail with respect to Fig. 14C, the M-frame 140 can also provide structural support to the display assembly that may allow the flat support chassis 402 to be thinned.

[0083] The cover glass frame 150 can include a rim 406 to which the cover glass 106 is bonded. The rim can be supported by a flange 414. As described above, rather than using a separate frame, in one embodiment, the rim 406 can be built into the housing 102 and the cover glass 106 can be bonded directly to the housing. For instance, the housing 102 can include a rim and flange for supporting the cover glass.

[0084] Because of the inward slope of housing 102, the cover glass frame 150 includes a hollowed out area 415. The hollowed out area 415 allows the display

assembly and hence the image services to be extended closer to the top edge of the housing 102. If the portion were not hollowed out, then the edge of the display would have to be set back farther from the top edge of the housing to accommodate the slope of the housing. To fit better into the hollowed out area 415, material can be removed from support chassis 404. For example, one or more edges of the support chasing 404 can be chamfered to fit better into the hollowed area 414. In one embodiment, the chamfer angle can be selected to proximately match the slope of the hollowed out area proximate to the edge of the support chassis.

[0085] Fig. 14C shows a cross sectional view of a display assembly coupled to a glass frame and a secondary support frame. In Fig. 14C, the support chassis 404a is bonded via a bonding agent to the M-frame 140. The bond is designed to allow structural stiffness associated with the M-frame to be transferred to the support chassis 404a and increase the display assembly's resistance to bending. In one embodiment, with the bonding to the M-frame 140, the support chassis 404a can be made thinner. To illustrate this feature, the support chassis 404a is shown as being thinner the support chassis 404 shown in Fig. 12B. As noted above, besides structural support, the M-frame may also provide thermal relief to the display assembly in locations where the display assembly tends to get hot.

[0086] Fig. 15 is a flow chart of a method 200 of forming a support chassis for a display assembly. In 202, thickness objectives can be determined for the support chassis for the display assembly and the M-frame. In 203, material properties for the M-frame and support chassis can be selected, i.e., the materials used to form each component. In 204, bending tolerances and test loads can be selected 204. In 206, the M-frame and the display chassis can each be sized such that a proximate thickness for each of the components is determined.

In 208, bending and associated bending moments can be simulated based upon the test loads and conditions select in 204. Based upon the simulations, the amount of bending can be compared to the bending tolerances selected in 204. If the thickness objectives are not met, then the M-frame and the support chassis can be resized in 206 and the simulations repeated until thickness objectives are met. This process can be repeated using different materials for the M-frame and the display support chassis. In 210, an M-frame and display assembly including the support chassis can be formed according

to the sizes determined in 206. In 212, a personal media device utilizing the M-frame and the display assembly can be assembled.

[0087] Fig. 16 is a block diagram of an arrangement 1300 of functional modules utilized by a portable media device. The portable media device can, for example, be portable media device 102 illustrated in Figs. 1 and 2. The arrangement 1300 includes a media player 1302 that is able to output media for a user of the portable media device but also store and retrieve data with respect to data storage 1304. The arrangement 1300 also includes a graphical user interface (GUI) manager 1306. The GUI manager 1306 operates to control information being provided to and displayed on a display device. The arrangement 1300 also includes a communication module 1308 that facilitates communication between the portable media device and an accessory device. Still further, the arrangement 1300 includes an accessory manager 1310 that operates to authenticate and acquire data from an accessory device that may be coupled to the portable media device. For example, the accessory device can be a wireless interface accessory, such as the wireless interface accessory 106 illustrated in FIG. 1 as being coupled to portable media device 102.

[0088] Fig. 17 is a block diagram of a media player 1350 suitable for use with the described embodiments. The media player 1350 illustrates circuitry of a representative portable media device. The media player 1350 includes a processor 1352 that pertains to a microprocessor or controller for controlling the overall operation of the media player 1350. The media player 1350 stores media data pertaining to media items in a file system 1354 and a cache 1356. The file system 1354 is, typically, a storage disk or a plurality of disks. The file system 1354 typically provides high capacity storage capability for the media player 1350. However, since the access time to the file system 1354 is relatively slow, the media player 1350 can also include a cache 1356. The cache 1356 is, for example, Random-Access Memory (RAM) provided by semiconductor memory. The relative access time to the cache 1356 is substantially shorter than for the file system 1354. However, the cache 1356 does not have the large storage capacity of the file system 1354. Further, the file system 1354, when active, consumes more power than does the cache 1356. The power consumption is often a concern when the media player 1350 is a portable media device that is powered by a battery 1374. The media player 1350

can also include a RAM 1370 and a Read-Only Memory (ROM) 1372. The ROM 1372 can store programs, utilities or processes to be executed in a non-volatile manner. The RAM 1370 provides volatile data storage, such as for the cache 1356.

[0089] The media player 1350 also includes a user input device 1358 that allows
5 a user of the media player 1350 to interact with the media player 1350. For example, the user input device 1358 can take a variety of forms, such as a button, keypad, dial, touch screen, audio input interface, video/image capture input interface, input in the form of sensor data, etc. Still further, the media player 1350 includes a display 1360 (screen display) that can be controlled by the processor 1352 to display information to
10 the user. A data bus 1366 can facilitate data transfer between at least the file system 1354, the cache 1356, the processor 1352, and the CODEC 1363.

[0090] In one embodiment, the media player 1350 serves to store a plurality of media items (e.g., songs, podcasts, etc.) in the file system 1354. When a user desires to have the media player play a particular media item, a list of available media items
15 is displayed on the display 1360. Then, using the user input device 1358, a user can select one of the available media items. The processor 1352, upon receiving a selection of a particular media item, supplies the media data (e.g., audio file) for the particular media item to a coder/decoder (CODEC) 1363. The CODEC 1363 then produces analog output signals for a speaker 1364. The speaker 1364 can be a
20 speaker internal to the media player 1350 or external to the media player 1350. For example, headphones or earphones that connect to the media player 1350 would be considered an external speaker.

[0091] The media player 1350 also includes a network/bus interface 1361 that
25 couples to a data link 1362. The data link 1362 allows the media player 1350 to couple to a host computer or to accessory devices. The data link 1362 can be provided over a wired connection or a wireless connection. In the case of a wireless connection, the network/bus interface 1361 can include a wireless transceiver. The media items (media assets) can pertain to one or more different types of media content. In one embodiment, the media items are audio tracks (e.g., songs, audio
30 books, and podcasts). In another embodiment, the media items are images (e.g., photos). However, in other embodiments, the media items can be any combination of audio, graphical or video content.

[0092] The foregoing description, for purposes of explanation, used specific nomenclature to provide a thorough understanding of the described embodiments. However, it will be apparent to one skilled in the art that the specific details are not required in order to practice the described embodiments. Thus, the foregoing
5 descriptions of the specific embodiments described herein are presented for purposes of illustration and description. They are not target to be exhaustive or to limit the embodiments to the precise forms disclosed. It will be apparent to one of ordinary skill in the art that many modifications and variations are possible in view of the above teachings.

CLAIMS

What is claimed is:

1. A method for heat sealing an electrical connector assembly, the electrical connector assembly having a plurality of electrical contacts each having a flat pad portion and an upraised portion in the form of a dimple, at least one window bracket arranged to engage a corresponding latch on a plug when the plug is inserted and engaged with the electrical connector assembly, comprising:
 - providing the connector assembly in component accessible state;
 - providing sealing tape, the sealing tape comprising a thin film impregnated with a heat sensitive adhesive;
 - overlaying the housing and the flat pad portion of at least some of the electrical contacts with the sealing tape leaving at least some of the dimples substantially exposed;
 - applying an amount of heat to the sealing tape, the amount of heat sufficient to liquify the heat sensitive adhesive such that the liquefied adhesive flows over a surface of the housing and the plurality of electrical contacts, wherein the dimples remain exposed; and
 - sealing the electrical contact assembly by allowing the liquefied adhesive to cure.
2. The method as recited in claim 1, further comprising
 - providing the sealed electrical contact assembly;
 - sliding a metal shell over the housing and the plurality of electrical contacts, the metal shell having openings corresponding to the dimples; and
 - laser welding the metal shell to the housing by targeting the exposed portions of the dimples.
3. The method as recited in claim 1, wherein the dimples are formed of electrically conductive material.
4. The method as recited in claim 1, further comprising:
 - providing an electrical device housing, the electrical device housing having an opening sized in accordance with the heat sealed electrical connector assembly housing; and
 - inserting the heat sealed electrical connector assembly into the opening; and

securing the heat sealed electrical connector to the housing, the housing having a curved shape, the curved shape providing greater support for securing the heat sealed electrical connector at a top portion of the housing than at a bottom portion of the housing.

5 5. The method as recited in claim 4, further comprising:

inserting a connector plug into an opening of the electrical connector assembly; and

in response to the inserting,

activating at least one spring activated dimple located at a bottom portion of the
10 connector plug causing the dimple to press upon a conductive portion of the connector plug with a spring force forming a conductive path from the connector plug to the housing as chassis ground.

6. An electrical connector assembly, comprising:

a plurality of electrical contacts enclosed in a bracket each having a flat pad
15 portion and an upraised portion in the form of a dimple, wherein at least one dimple is spring activated, the spring activated dimple forming an EMI ground tab; and

a metal housing, the metal housing laser welded to bracket using at least one exposed dimple as a laser target.

7. The electrical connector assembly as recited in claim 6, wherein the bracket is
20 arranged to engage an associated latch on a connector plug when the connector plug is inserted into and engages the electrical connector assembly, wherein electrical connector assembly is heat sealed using sealing tape impregnated with heat sensitive adhesive, the sealing tape overlaying the housing, the flat pad portion of at least some of the electrical contacts and at least a portion of the dimples, wherein an upper part
25 of the dimples remains exposed

8. The electrical connector assembly as recited in claim 7, wherein the electrical connector assembly is inserted into an opening in a device housing, the device housing having a curved shape such that a top portion of the housing provides greater support for the electrical connector assembly than does a bottom portion of the
30 housing.

9. The electrical connector assembly as recited in claim 7, further comprising:
a spring mechanism, the spring mechanism attached to a corresponding one of the dimples, spring mechanism imparting a spring force onto the dimple when a connector plug is inserted into the electrical connector assembly.
- 5 10. The electrical connector assembly as recited in claim 8, wherein the spring activated dimple forms a ground path between the inserted connector plug and the housing.
11. A moisture sealed electrical connector assembly, comprises:
a plurality of electrical contacts exposed to an external environment, wherein
10 each of the plurality of electrical contacts has a flat pad portion and an upraised portion in the form of a dimple, wherein at least one dimple is spring activated, the spring activated dimple forming an EMI ground tab;
a bracket, the bracket arranged to engage an associated latch on a connector plug when the connector plug is inserted into and engages the electrical connector
15 assembly, wherein electrical connector assembly is heat sealed using sealing tape impregnated with heat sensitive adhesive, the sealing tape overlaying the housing, the flat pad portion of at least some of the electrical contacts and at least a portion of the dimples, wherein an upper part of the dimples remains exposed; and
a metal housing, the metal housing laser welded to bracket using at least one
20 exposed dimple as a laser target, wherein the overlaid sealing tape prevents moisture passing from the external environment via the electrical contacts to the interior of the device housing thereby protecting the operational components from moisture related contamination.
12. The moisture sealed electrical connector assembly as recited in claim 11,
25 wherein the moisture sealed electrical connector assembly is disposed within an opening in a housing of an electronic device.
13. The moisture sealed electrical connector assembly as recited in claim 12,
wherein the electrical connector assembly is inserted into the opening in the housing, the housing having a curved shape such that a top portion of the housing provides
30 greater support for the electrical connector assembly than does a bottom portion of the housing.

14. The electronic device as recited in claim 13, further comprising:
a spring mechanism, the spring mechanism attached to a corresponding one of the dimples, spring mechanism imparting a spring force onto the dimple when a connector plug is inserted into the electrical connector assembly.
- 5 15. The electronic device as recited in claim 14, wherein the spring activated dimple forms a ground path between the inserted connector plug and the housing.
16. A method of preventing moisture intrusion from an external environment into an interior of an electronic device having a housing with an opening to the external environment, comprising:
- 10 providing a heat sealed electrical connector assembly, the heat sealed electrical connector assembly comprising:
a plurality of electrical contacts at least a portion of which are exposed to the external environment, wherein each of the electrical contacts is sealed to prevent the transport of moisture from the external environment to the interior of the electronic
15 device;
placing the heat sealed electrical connector assembly within the opening; and
securing the heat sealed electrical connector assembly to the opening, wherein the heat sealed electrical connector assembly substantially prevents moisture from passing from the exterior environment to the interior of the electronic device.
- 20 17. The method as recited in claim 16, wherein the electrical connector assembly is heat sealed by,
providing the electrical connector assembly in component accessible state;
providing an amount of sealing tape, the sealing tape comprising a thin film impregnated with a heat sensitive adhesive;
- 25 overlaying a flat pad portion of at least some of the electrical contacts with the sealing tape leaving at least some upraised portion (dimples)substantially exposed;
heating the sealing tape to liquefy the heat sensitive adhesive such that the liquefied adhesive flows over a surface of overlaid portion of the electrical connector assembly and the plurality of electrical contacts, wherein the dimples remain exposed;
- 30 and
curing the liquefied adhesive to complete the sealing.

18. The method as recited in claim 14, wherein the dimples are formed of electrically conductive material.

19. The method as recited in claim 18, further comprising:

attaching a spring mechanism at least one of the dimples; and

5 applying a spring force by the spring mechanism onto the dimple when a connector plug is inserted into an opening of the electrical connector assembly thereby forming a ground path between the inserted connector plug and the housing.

20. A multi-pin connector assembly arranged to facilitate an electrical connection between an electronic device and an external circuit, comprising:

10 an electrically insulating enclosure having a size and shape arranged to mechanically engage a connector plug in an engaged state, the connector plug having an electrically conductive body, wherein the enclosure comprises:

a top portion having at least two leaf type contacts arranged to provide electrical connections to corresponding ground tabs on the connector plug body in the
15 engaged state, and

a bottom portion having at least two ground contacts formed of highly conductive material each mechanically coupled to a spring assembly, wherein in the engaged state, the spring assembly applies a spring force F_{spring} to the at least two ground contacts causing the at least two ground contacts to make electrical contact
20 with the connector plug body.

21. The multi-pin connector assembly as recited in claim 20, wherein the multi-pin connector assembly is accommodated within an opening formed in a spline shaped housing of an electronic device having internal circuitry.

22. The multi-pin connector assembly as recited in claim 21, wherein in an
25 engaged state, the multi-pin connector assembly mechanically engages a connector plug to form an electrical connection between the internal circuitry of the electronic device and the external circuit.

23. The multi-pin connector assembly as recited in claim 22, wherein the top portion engages more of the spline shaped housing of the electronic device than does
30 the bottom portion of the multi-pin connector assembly.

24. The multi-pin connector assembly as recited in claim 23, wherein the at least two ground contacts take the form of dimples having a base portion and a raised portion that comes in contact with the connector plug housing in the engaged state.
25. The multi-pin connector assembly as recited in claim 24, wherein the dimples
5 are formed of formed of any of stainless steel and copper.
26. The multi-pin connector assembly as recited in claim 25, wherein the spring force F_{spring} is about 150 grams of force.
27. The multi-pin connector assembly as recited n claim 26, wherein the multi-pin
10 connector assembly includes at least 30 electrical contacts that form the electrical connection.
28. The multi-pin connector assembly as recited in claim 20 wherein the electrically insulating enclosure is formed of plastic.
29. A personal media device, comprising:
a housing having at least a highly curved portion wherein the housing includes
15 at least one opening suitably sized to accommodate a multi-pin connector; and
a multi-pin connector assembly at least a part of which is associated with the highly curved portion of the housing, wherein the part of the multi-pin connector assembly associated with the highly curved portion of the housing includes at least a
spring loaded, small form factor, electrical contact assembly arranged to provide EMI
20 ground contact between the multi-pin connector assembly and a conductive shell of a connector plug when the connector plug is inserted into and engages the multi-pin connector assembly.
30. The personal media device as recited in claim 29, wherein the multi-pin
connector assembly further comprises:
25 an electrically insulating enclosure having a size and shape arranged to mechanically engage the connector plug in the engaged state , wherein the enclosure comprises:
a top portion having at least two leaf type contacts arranged to provide
electrical connections to corresponding portions of the connector shell in the engaged
30 state, and
a bottom portion having the spring loaded, small factor electrical contact comprising at least two ground contacts formed of highly conductive material each

mechanically coupled to a spring assembly, wherein in the engaged state, the spring assembly applies a spring force F_{spring} to the at least two ground contacts causing the at least two ground contacts to make electrical contact with the connector shell.

31. The personal media device as recited in claim 30, wherein the multi-pin connector assembly is accommodated within an opening formed in the highly curved portion of the housing.

32. The personal media device as recited in claim 31, wherein in an engaged state, the multi-pin connector assembly mechanically engages the connector plug to form an electrical connection between internal circuitry of the electronic device and an external circuit.

33. The personal media device as recited in claim 32, wherein the top portion engages more of the highly curved portion of the housing of the electronic device than does the bottom portion of the multi-pin connector assembly.

34. The personal media device as recited in claim 33, wherein the at least two ground contacts take the form of dimples having a base portion and a raised portion that comes in contact with the conductive shell in the engaged state.

35. The personal media device as recited in claim 34, wherein the dimples are formed of any of stainless steel and copper.

36. The personal media device as recited in claim 35, wherein the spring force F_{spring} is about 150 grams of force.

37. The personal media device as recited in claim 36, wherein the multi-pin connector assembly includes at least 30 electrical contacts that form the electrical connection.

38. A method of manufacturing an electronic device, comprising:
providing a housing having at least a highly curved portion;
forming at least one opening in the highly curved portion of the housing suitably sized to accommodate a multi-pin connector;
providing the multi-pin connector assembly;
inserting the multi-pin connector assembly into the opening; and
securing the multi-pin connector to highly curved portion of the housing, wherein the multi-pin connector comprises:

an electrically insulating enclosure having a size and shape arranged to mechanically engage a connector plug in an engaged state to form an electrical connection between internal circuits in the electronic device and an external circuit, the connector plug having an electrically conductive body for providing a ground, wherein the enclosure comprises:

a top portion having at least two leaf type contacts arranged to provide electrical connections to corresponding ground tabs on the connector plug body in the engaged state, and

a bottom portion having at least two ground contacts formed of highly conductive material each mechanically coupled to a spring assembly, wherein in the engaged state, the spring assembly applies a spring force F_{spring} to the at least two ground contacts causing the at least two ground contacts to make electrical contact with the connector plug body.

39. The method as recited in claim 38, wherein the top portion engages more of the spline highly curved portion of the housing of the electronic device than does the bottom portion of the multi-pin connector assembly.

40. The method as recited in claim 39, wherein the at least two ground contacts take the form of dimples having a base portion and a raised portion that comes in contact with the connector plug housing in the engaged state.

41. The method as recited in claim 40, wherein the dimples are formed of formed of any of stainless steel and copper.

42. The method as recited in claim 41, wherein the spring force F_{spring} is about 150 grams of force.

43. A display assembly, comprising:
a protective cover layer;
a display stack, the display stack, the display stack including a plurality of display components arranged in a plurality of interconnected layers, the display stack providing an imaging service;

a flat support chassis, the flat support chassis arranged to provide support for the display stack, wherein the display stack is positioned between the protective cover layer and the flat support chassis.

44. The display assembly as recited in claim 43, wherein the display assembly protective cover layer is attached to a support frame.
45. The display assembly as recited in claim 44, wherein the flat support chassis comprises at least one chamfered edge, the chamfered edge having a size and shape in accordance with the support frame.
46. The display assembly as recited in claim 45, wherein the support frame is attached to a housing of a small form factor portable electronic device.
47. The display assembly as recited in claim 46, wherein the flat support chassis is attached to the support frame such that the display assembly is essentially isolated from applied loads at the housing.
48. The display assembly as recited in claim 43, wherein the display assembly is the flat support chassis is attached to a support frame wherein the support frame configured to a) increase a stiffness of the flat support chassis, b) provide heat dissipation for the display assembly or c) combinations thereof.
49. A structural support system for a personal media device comprising:
a housing formed with a cavity for receiving at least a display assembly including a flat support chassis, the housing including sloped sides such that the housing is thinner near its outer perimeter and thicker near its center;
a first structure including a rim for supporting a protective cover layer, the protective cover layer configured to fit over the cavity and cover the display assembly;
a second structure including a groove proximate to the outer perimeter of housing, the groove configured to receive an outer portion of the flat support chassis; and
a third structure disposed beneath the display assembly, the third structure at least thermally coupled to the flat support chassis to provide thermal dissipation of heat generated from the display assembly.
50. The structural support system of claim 49, wherein the first structure and the second structure are integrally formed into the housing.
51. The structural support system of claim 49, wherein the first structure and the second structure are formed on a frame configured to fit within the cavity around its outer perimeter.

52. The structural support system of claim 49, wherein the outer portion of the flat support chassis are chamfered to allow the flat support chassis to be aligned with and fit within the groove of the second structure.
53. The structural support system of claim 49, wherein the display assembly is
5 bonded to the display cover glass.
54. The structural support system of claim 49, wherein the third structure is a substantially flat sheet that spans across the cavity from a first side of the housing to a second side of the housing wherein the flat support chassis is bonded to sheet to increase a stiffness of the display assembly.
- 10 55. A personal media device comprising:
a housing formed with a cavity; and
a display assembly configured to fit within the cavity, the display assembly comprising:
a protective cover layer;
15 a display stack, the display stack, the display stack including a plurality of display components arranged in a plurality of interconnected layers, the display stack providing an imaging service;
a flat support chassis, the flat support chassis arranged to provide support for the display stack, wherein the display stack is positioned between the protective cover
20 layer and the flat support chassis wherein the protective cover layer configured to fit over a top of the cavity such that the display stack, a main logic board, a memory and a battery are enclosed within a space formed by the protective cover layer and the cavity of the housing.
56. The personal media device of claim 55, further comprising:
25 a first structure including a rim for supporting the protective cover layer.
57. The personal media device of claim 56, wherein the first structure is formed in the housing proximate to its outer perimeter.
58. The personal media device of claim 55, further comprising:
a frame including 1) a rim for supporting an outer edge of the protective cover
30 layer, the protective cover layer configured to fit over the cavity and cover the display assembly and 2) a groove for receiving an outer portion of the flat support chassis wherein frame is configured to fit around an outer perimeter of the housing.

59. The personal media device of claim 58, where the outer portion of the flat support chassis is chamfered.

60. The personal media device of claim 55, further comprising a frame disposed beneath the display assembly and coupled to the housing, the frame coupled to the flat support chassis wherein the frame is configured to increase a stiffness of the display assembly and dissipate heat generated by the display assembly.

61. A method of forming a personal media device comprising:
forming a display assembly including a flat support chassis,
a protective cover layer and a display stack for providing imaging services
disposed between the flat support chassis and the protective cover layer the display assembly;

forming a housing including a cavity for receiving the display assembly such that the display stack fits within the cavity; and
attaching the display assembly to the housing.

62. The method of claim 61, further comprising:
forming a structure including a rim for supporting an outer edge of the protective cover layer wherein the structure is coupled to the housing and attaching the outer edge of the protective cover layer to the rim.

63. The method of claim 62, further comprising:
forming a frame including the structure and attaching the frame to the housing.

64. The method of claim 62, further comprising:
forming a structure including a groove for receiving an outer edge of the flat support chassis.

65. The method of claim 63, further comprising:
chamfering the outer edge of the flat support chassis to help align and fit the outer edge within the groove.

66. A non-transitory computer readable medium for storing computer code executed by a processor in a computer aided manufacturing process comprising:
computer code for forming a display assembly including a flat support chassis,
a protective cover layer and a display stack for providing imaging services
disposed between the flat support chassis and the protective cover layer the display assembly;

computer code for forming a housing including a cavity for receiving the display assembly such that the display stack fits within the cavity; and

computer code for attaching the display assembly to the housing.

67. The method of claim 66, further comprising:

- 5 computer forming a structure including a groove for receiving an outer edge of the flat support chassis and computer code for chamfering the outer edge of the flat support chassis to help align and fit the outer edge within the groove.