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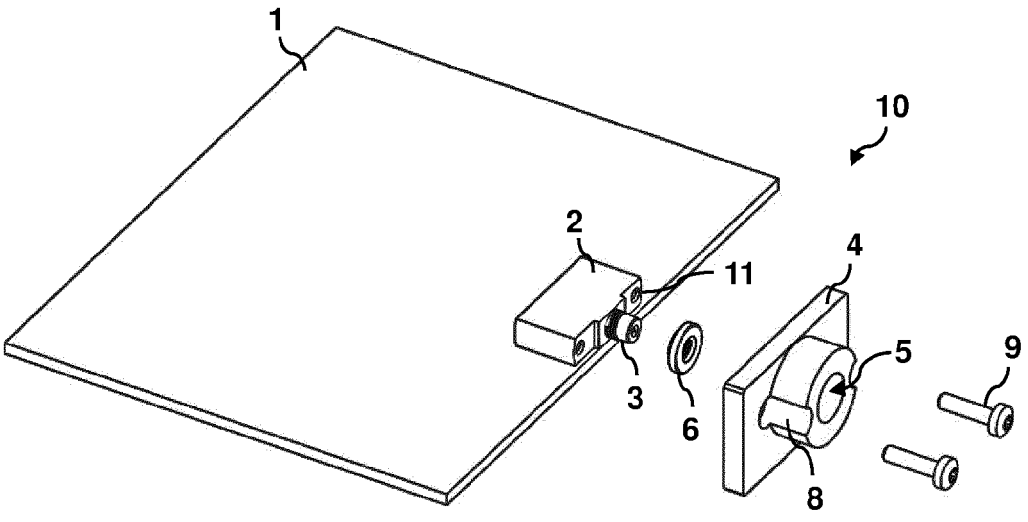
(54) RF CONNECTOR FOR CONTACTING A PRINTED CIRCUIT BOARD

(57) An RF connector for contacting a printed circuit board (PCB) comprises an RF socket configured to be mounted to the PCB, the RF socket providing a coaxial terminal with a first diameter; a port flange configured to be plugged on the RF socket and providing a plug-in port with a second diameter for receiving another RF connector to be contacted to the RF socket, the second diameter being larger than the first diameter; and a centering nut configured to be disposed between the RF socket and the port flange for centering the port flange with respect to the RF socket, wherein the centering nut has an inner diameter corresponding to the first diameter of the RF socket and an outer diameter corresponding to the second diameter of the port flange.

Fig. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an RF connector for contacting a printed circuit board.

BACKGROUND

[0002] Radio frequency (RF) connectors can be mounted to printed circuit boards (PCB) of electronic devices, e.g. measurement instruments, in order to contact the respective apparatus with coaxial cables or the like. On the one hand, it is beneficial if the installation process of these connectors is kept as quick and simple as possible without the need for complex and expensive mounting tools. On the other hand, the mechanical and electrical contact should be stable and durable. Amongst others, the RF connection should be reasonably free of mechanical stress.

[0003] Providing such an RF connector with a small sized coaxial contact terminal can simplify the soldering process as soldering larger metal components usually requires higher temperatures and mechanical loads during soldering. Small terminals on the other hand imply small connectors, which may have lower mechanical stability. Connectors with large outer conductors may also be fastened by clamping, which however may be electrically less stable. Moreover, the installation of common connectors usually relies on the usage of centering tools, which usually have to be removed afterwards making the installation process laborious.

[0004] Prior art document EP 3 432 424 A1 describes an RF connector system, wherein a mechanical connection is made by two wing shaped surface mount sections of a housing having a plurality of surface mount studs adapted to match which pads on a PCB. The electrical connection to the PCB is made by an inner conductor and at least one matching block electrically connected to the housing and providing a matched impedance at the PCB, which has a strip line with a ground plane.

[0005] WO 2020/006195 A1 describes an enhanced electrical grounding of hybrid feed-through connectors.

SUMMARY

[0006] Against this background, there is a need to find solutions for contacting PCBs with RF connectors that provide a better trade-off between mechanical and electrical stability and installation effort.

[0007] To this end, the present invention provides an RF connector having the features of the independent claim.

[0008] According to an aspect of the invention, an RF connector for contacting a printed circuit board (PCB) comprises an RF socket configured to be mounted to the PCB, the RF socket providing a coaxial terminal with a first diameter; a port flange configured to be plugged on the RF socket and providing a plug-in port with a second diameter for receiving another RF connector to be contacted to the RF socket, the second diameter being larger than the first diameter; and a centering nut configured to be disposed between the RF socket and the port flange for centering the port flange with respect to the RF socket, wherein the centering nut has an inner diameter corresponding to the first diameter of the RF socket and an outer diameter corresponding to the second diameter of the port flange.

[0009] Thus, one of the idea of the present invention is to attach a port flange of larger diameter to a small base connector of smaller diameter and thereby enlarge the effective contact diameter of the setup and thus its rigidity against mechanical stress, e.g. shear forces. The RF properties of the arrangement may be determined by the RF socket only and may remain unaffected by the port flange, which may serve exclusively as a mechanical support for the arrangement in order to be able to couple connectors of larger diameter to the PCB. Alignment of the setup is then ensured by arranging the centering nut between the RF socket and the port flange, where it may stay permanently. To this end, the internal diameter of the nut corresponds to the external diameter of the base body, while the external diameter of the nut corresponds to the diameter of the port flange (the fit between the components may leave some level of play in order to facilitate installation). The setup of the invention is thus particularly simple to install and yet offers improved stability against mechanical and electrical influences.

[0010] Further embodiments of the present invention are subject of the subordinate claims and of the following description, referring to the drawings.

[0011] According to an embodiment of the invention, the centering nut may be configured with an inner thread to be screwed upon the RF socket.

[0012] The installation process may thus be kept as straightforward as possible. In one example, installation of the setup may proceed as follows:

- the port flange may be loosely pre-assembled to the RF socket, e.g. by plugging it onto the RF socket without final fixation,
- the centering nut may then be screwed onto an external thread of the RF socket with a defined torque for permanent retention, e.g. by reaching through the plug-in port of the port flange with a suitable assembly tool (the centering nut may have been positioned on the RF socket already before the port flange is plugged onto it, or, alternatively, the centering nut may be introduced only subsequently through the plug-in port of the port flange),
- the now centered port flange may be fixed tight, e.g. by screwing it to the RF socket,
- optionally, the port may additionally be fixed to a device housing, e.g. also by screws.

[0013] According to an embodiment of the invention,

the centering nut may be configured with at least one assembly portion adapted to be engaged by an assembly tool.

[0014] For example, the centering nut may be provided with holes, grooves and/or recesses or the like, which may be engaged by suitable assembly tools, e.g. by reaching through the plug-in port of the port flange.

[0015] According to an embodiment of the invention, the centering nut may be formed from a metal material.

[0016] In principle any material with adequate strength and durability may be suitable for the present purpose, in particular electrically conducting materials.

[0017] According to an embodiment of the invention, the centering nut may comprise at least one of steel and copper-beryllium.

[0018] Beryllium copper combines high strength with excellent metalworking, forming and machining properties. The centering nut may thus be formed with materials that retain their shape even under repeated stress and strain.

[0019] According to an embodiment of the invention, the port flange may comprise at least one mounting interface for fastening the port flange to at least one of the RF socket and a PCB housing.

[0020] For example, the port flange may be provided with one or several fastening (through) holes for receiving corresponding fastening elements like screws, bolts or the like, which then may enter and engage corresponding holes within the RF socket and/or a PCB housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] For a more complete understanding of the present invention and advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings. The invention is explained in more detail below using exemplary embodiments which are specified in the schematic figures of the drawings, in which:

Fig. 1 shows an explosive perspective view of a PCB with an RF connector according to an embodiment of the present invention; and

Fig. 2 shows a detailed perspective view of a centering nut used in the RF connector of Fig. 1.

[0022] The appended drawings are intended to provide further understanding of the embodiments of the invention. They illustrate embodiments and, in conjunction with the description, help to explain principles and concepts of the invention. Other embodiments and many of the advantages mentioned become apparent in view of the drawings. The elements in the drawings are not necessarily shown to scale.

[0023] In the drawings, like, functionally equivalent and identically operating elements, features and components are provided with like reference signs in each case, unless stated otherwise.

DETAILED DESCRIPTION OF THE DRAWINGS

[0024] Figure 1 shows an explosive perspective view of a PCB 1 with an RF connector 10 according to an embodiment of the present invention.

[0025] Radio frequency (RF) and/or coaxial connectors are a key component in RF and microwave applications where they are frequently used in test and measurement equipment to connect coaxial cables with the respective read-out or signal generating system components, e.g. in signal and spectrum analyzers and/or generators, test systems for antennas and other electromagnetic equipment, oscilloscopes etc. In most of these applications it is paramount to utilize connectors that allow accurate and repeatable measurements while being durable and highly performant at the same time.

[0026] Hence, the RF connection with a PCB 1, e.g. being part of an electronic measurement device, should not only be easy to assemble in order to safe costs and manufacturing time but should also provide a connection that is mechanically and electrically stable. The presently described solution for an RF connector provides an RF connection that offers all of these advantages.

[0027] Specifically, the RF connector 10 of the exemplary embodiment of Figs. 1 and 2 comprises an RF socket 2 adapted to be mounted to a PCB 1 and providing a coaxial terminal 3 with a first diameter. The RF socket 2 may be placed upon and contacted to the PCB 1 in the usual vein, e.g. by soldering. It may be accommodated in a small box-like or cuboid housing, from which the coaxial terminal 3 protrudes. In order to simplify the soldering process and to facilitate a robust connection to the PCB 1, the coaxial terminal 3 may feature a relatively small diameter (e.g. roughly 4 mm).

[0028] In order to be able to use larger RF plugs in combination with this RF socket 2, the RF connector 10 is complemented by a port flange 4 configured to be plugged on the RF socket 2 and providing a plug-in port 5 with a second larger diameter (e.g. roughly 8 mm) for receiving another RF connector (not shown) to be contacted to the RF socket 2. In this case the port flange 4 is a mechanical plate-shaped retainer having a cylindrical extension with a through-hole serving as plug-in port 5 for other RF connectors and/or cables. The port flange 4 may be plugged at its plug-in port 5 on the coaxial terminal 3 of the RF socket 2.

[0029] In the embodiment of Fig. 1, the port flange 4 comprises two further through-holes as mounting interfaces 8 for fastening the port flange 4 to the RF socket 2 by inserting two fastening elements 9 (e.g. screws) through the mounting interfaces 8 into respective fastening holes 11 in the RF socket 2. In addition, the port flange 4 may also be fastened to a housing of the PCB 1 (not shown in Fig. 1) by similar means in order to further optimize the absorption of mechanical loads and to make the whole assembly more rigid.

[0030] To ensure adequate alignment between the port flange 4 and the RF socket 2 and thus of a coaxial connection with the PCB 1, the RF connector 10 further comprises a centering nut 6 as exemplarily shown in Fig. 2. The centering nut 6 is configured to be disposed between the RF socket 2 and the port flange 4 for centering the port flange 4 with respect to the RF socket 2. To this end, the centering nut 6 is configured with an inner diameter 6a corresponding to the first diameter of the RF socket 2 and an outer diameter 6b corresponding to the second diameter of the port flange 4. The centering nut 6 may be formed from metal with high strength, e.g. steel or a copper-beryllium alloy, to guarantee a mechanically stable and well aligned connection even under long and frequent usage of the assembly.

[0031] In the embodiment of Fig. 2, the centering nut 6 is provided with an inner thread to be screwed upon the coaxial terminal 3 of the RF socket 2 (which is provided with a complementary formed outer thread not shown in Fig. 1). Moreover, the centering nut 6 may feature one or several assembly portions 12 adapted to be engaged by an assembly tool to ease the installation process. In the exemplary embodiment of Fig. 2, the centering nut 6 is provided with two ring-shaped grooves running around the inner and outer diameters of the nut 6, respectively, so that the nut 6 can be engaged by a suitable tool through the plug-in port 5 of the port flange 4 in order to apply a rotary moment to the nut 6.

[0032] Thus assembly of the RF connector 10 may comprise pre-mounting the port flange 4 to the RF socket 2 by plugging it onto the RF socket 2 without (final) fixation (the fastening elements 9 are either not yet inserted or are at least not yet tightened). At this point, the centering nut 6 may have already been placed on the coaxial terminal 3 (also only loosely). Alternatively however, the centering nut 6 may be inserted through the plug-in port 5 of the port flange 4 subsequently. Next, the assembly may comprise screwing the centering nut 6 onto the coaxial terminal 3 of the RF socket 2 with a defined torque for permanent retention. Then, the now centered port flange 4 may be fixed tight, e.g. by screwing it to the RF socket 2. Finally, the port flange 4 may get fastened to a device housing, e.g. by further fastening elements.

[0033] As a result, an RF connector 10 is assembled on top of a PCB 1 featuring a port flange 4 with a large outer diameter for coupling RF connectors and cables to the PCB that is able to withstand high mechanical loads and stress. The connection is well aligned due to the intermediate nut 6 between the RF socket 2 and the port flange 4, which can be kept permanently within the assembly. The assembly process is simple and straightforward, eliminating the need to apply and remove the commonly used centering tools.

[0034] Although specific embodiments have been illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations exist. It should be appreciated that the exemplary embodiment or exemplary embodiments are only examples, and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents. Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein.

[0035] In the foregoing detailed description, various features are grouped together in one or more examples or examples for the purpose of streamlining the disclosure. It is understood that the above description is intended to be illustrative, and not restrictive. It is intended to cover all alternatives, modifications and equivalents as may be included within the scope of the invention. Many other examples will be apparent to one skilled in the art upon reviewing the above specification.

[0036] Specific nomenclature used in the foregoing specification is used to provide a thorough understanding of the invention. However, it will be apparent to one skilled in the art in light of the specification provided herein that the specific details are not required in order to practice the invention. Thus, the foregoing descriptions of specific embodiments of the present invention are presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed; obviously many modifications and variations are possible in view of the above teachings. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, to thereby enable others skilled in the art to best utilize the invention and various embodiments with various modifications as are suited to the particular use contemplated. Throughout the specification, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein," respectively. Moreover, the terms "first," "second," and "third," etc., are used merely as labels, and are not intended to impose numerical requirements on or to establish a certain ranking of importance of their objects.

List of reference signs

[0037]

1	printed circuit board (PCB)
2	RF socket
3	coaxial terminal
4	port flange
5	plug-in port
6	centering nut
6a	inner diameter
6b	outer diameter

7 inner thread
8 mounting interface
9 fastening element
10 RF connector
11 fastening hole
12 assembly portion

Claims

1. RF connector (10) for contacting a printed circuit board, PCB, (1), the RF connector (10) comprising:

   an RF socket (2) configured to be mounted to the PCB (1), the RF socket (2) providing a coaxial terminal (3) with a first diameter;
   a port flange (4) configured to be plugged on the RF socket (2) and providing a plug-in port (5) with a second diameter for receiving another RF connector to be contacted to the RF socket (2), the second diameter being larger than the first diameter; and
   a centering nut (6) configured to be disposed between the RF socket (2) and the port flange (4) for centering the port flange (4) with respect to the RF socket (2), wherein the centering nut (6) has an inner diameter (6a) corresponding to the first diameter of the RF socket (2) and an outer diameter (6b) corresponding to the second diameter of the port flange (4) .

2. RF connector according to claim 1, wherein the centering nut (6) is configured with an inner thread (7) to be screwed upon the RF socket (2).

3. RF connector according to any of the preceding claims, wherein the centering nut (6) is configured with at least one assembly portion (12) adapted to be engaged by an assembly tool.

4. RF connector according to any of the preceding claims, wherein the centering nut (6) is formed from a metal material.

5. RF connector according to any of the preceding claims, wherein the centering nut (6) comprises at least one of steel and copper-beryllium.

6. RF connector according to any of the preceding claims, wherein the port flange (4) comprises at least one mounting interface (8) for fastening the port flange to at least one of the RF socket (2) and a PCB housing.

Fig. 1

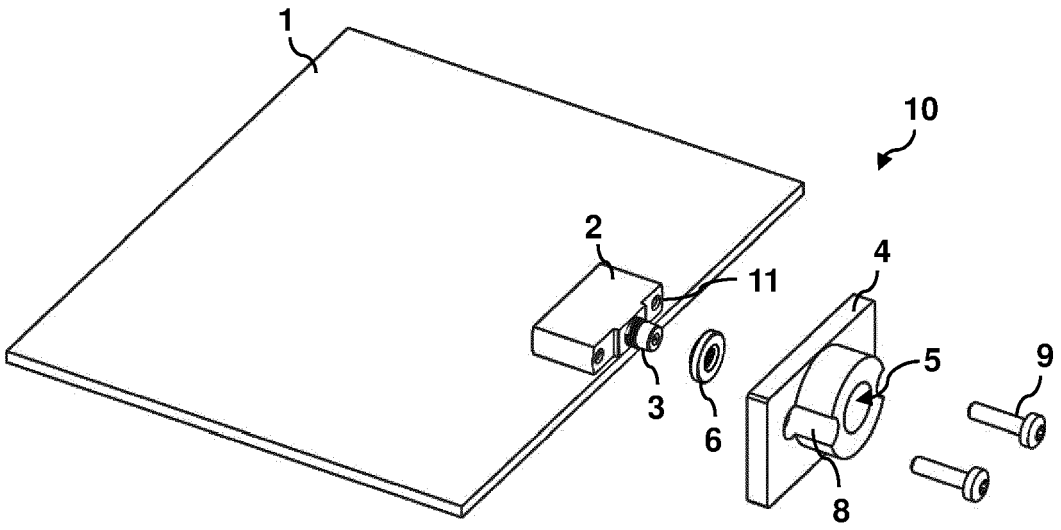
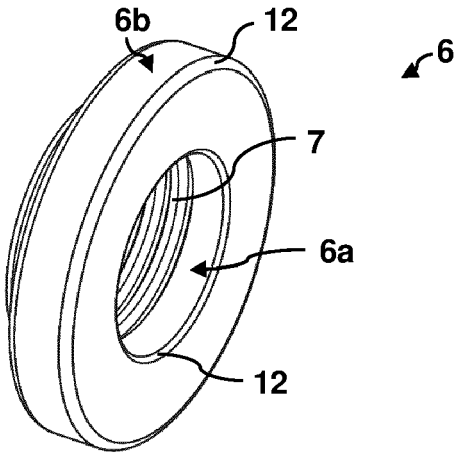


Fig. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 8997

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 824 392 B1 (GUO PONY [TW]) 30 November 2004 (2004-11-30) * column 3, lines 20-30; figures 3, 6 *	1-6	INV. H01R24/52 H01R24/50 H01R24/54 H01R103/00
A	JP 2011 134720 A (FUJITSU GENERAL LTD) 7 July 2011 (2011-07-07) * the whole document *	1-6	
A	GB 2 512 822 A (CAMBRIDGE ELECTRONIC IND LTD [GB]) 15 October 2014 (2014-10-15) * the whole document *	1-6	

TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 May 2022	López García, Raquel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

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02-05-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6824392 B1	30-11-2004	NONE	
JP 2011134720 A	07-07-2011	NONE	
GB 2512822 A	15-10-2014	NONE	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 3432424 A1 **[0004]**
- WO 2020006195 A1 **[0005]**