(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 557 699 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.10.2019 Bulletin 2019/43

(21) Application number: **18167756.8**

(22) Date of filing: **17.04.2018**

(51) Int Cl.:
H01R 13/6599 *(2011.01)* ***H05K 9/00*** *(2006.01)*
H01R 13/506 *(2006.01)* *H01R 13/627* *(2006.01)*
H01R 13/422 *(2006.01)* *H01R 13/58* *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **TE Connectivity Germany GmbH**
64625 Bensheim (DE)

(72) Inventors:
- **Kidane, Abiel**
  68169 Mannheim (DE)
- **Nikfalazar, Mohammad**
  64293 Darmstadt (DE)
- **Lawrence, Aruna**
  64673 Zwingenberg (DE)

(74) Representative: **Patentanwaltskanzlei WILHELM & BECK**
Prinzenstraße 13
80639 München (DE)

(54) CONNECTOR WITH REDUCED ELECTROMAGNETIC INTERFERENCES

(57) The invention relates to an electrical connector comprising a housing for receiving and fixing a housing insert, the housing insert with a wire fixture disposed inside the housing insert, a sealing member disposed at an end of the housing relative to a plug direction, at least one electrical wire received and positioned by the wire fixture and extending through the sealing member, wherein at least one of the components of the electrical connector comprises a material with properties for dampening an electrical field strength created by the at least one electrical wire.

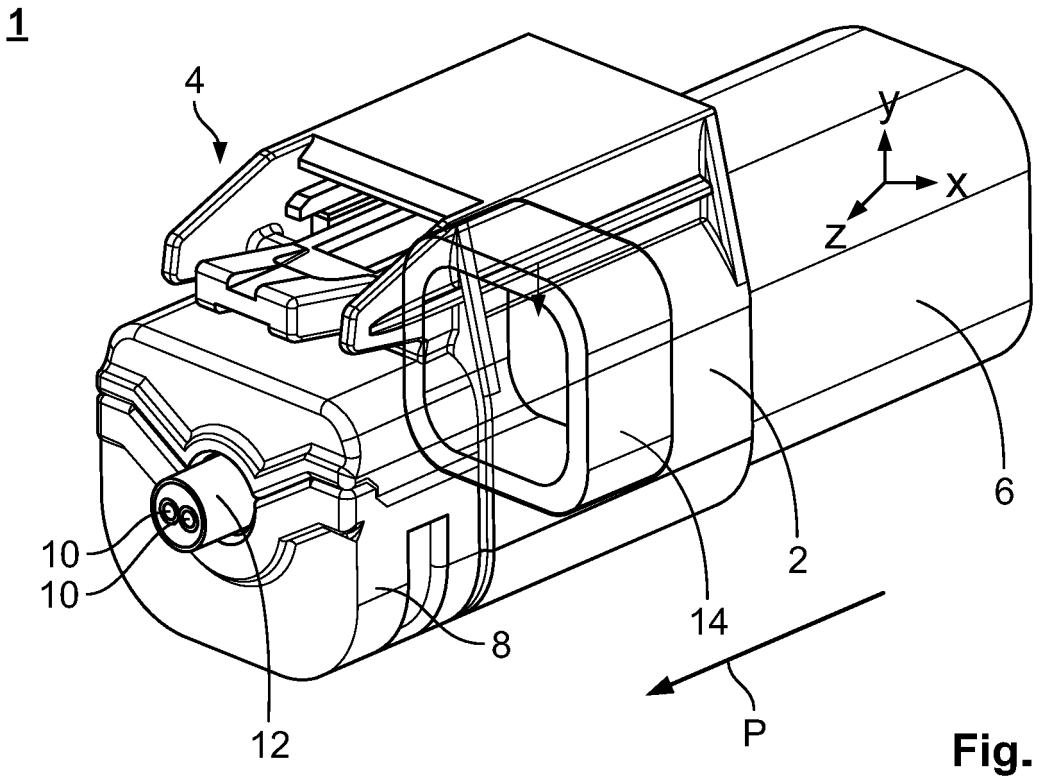

Fig. 1

EP 3 557 699 A1

Description

[0001] The invention relates to an electrical connector comprising a housing for receiving and fixing a housing insert, the housing insert with a wire fixture disposed inside the housing insert, a sealing member disposed at an end of the housing relative to a plug direction and at least one electrical wire received and positioned by the wire fixture and extending through the sealing member.

[0002] Current plastic materials used in connector bodies are not developed for an increased performance with regard to an electromagnetic interference (EMI). They permit the electrical field to radiate out of the connector housing. Hence mutual coupling or cross talk between communication links can be increased.

[0003] It is known to provide an electrically conductive shield for reducing cross talk effects between communication links and to improve the EMI performance of a connector. In EP 0 742 683 A1 a flexible conductive sheet as an EMI shield is disclosed. An electronic device is shielded against electromagnetic interference using the flexible conductive sheet forming a shield barrier or enclosure. The sheet is composed of electrically insulating polymer material exposed on the surface of at least one face of the sheet.

[0004] Such devices and connectors have to be initially designed and constructed such that EMI shields can be inserted inside of housings or arranged outside of housings. Hence, retrofitting existing connector designs with improved EMI performance is usually not possible.

[0005] Therefore, the object underlying the invention can be seen as consisting in specifying an electric connecter with improved EMI performance and which can be upgraded subsequently without changing the initial design of the connector.

[0006] This object is achieved by means of the respective subject-matter of the independent claim. Advantageous embodiments are subject-matter of respective dependent claims.

[0007] According to one aspect, an electrical connector is provided. The electrical connector comprises a housing for receiving and fixing a housing insert inside an inner portion.

[0008] Furthermore, the electrical connector comprises the housing insert with a wire fixture disposed inside the housing insert. A sealing member is disposed at an end of the housing of the electrical connector relative to a plug direction.

[0009] At least one electrical wire is received and positioned by the wire fixture and is extending through the sealing member, wherein at least one of the components of the electrical connector comprises a material with properties for dampening an electrical field strength created by the at least one electrical wire.

[0010] Due to the materials with properties for dampening an electrical field strength, the EMI performance of the electrical connector can be improved. The already existing parts of the electrical connector may be replaced by components composed of alternative materials without redesigning corresponding components.

[0011] The EMI may be reduced by increasing the dielectric constant and loss tangent of at least one of the components of the electric connector. Preferably, the dielectric constant is higher than 2. For example the housing, the housing insert, the wire fixture and/or the sealing member may be manufactured with a modified material composition such that the dielectric properties are allowing stronger dampening effects with regard to the electric field.

[0012] Preferably, the electrical connector can be a terminal connector or header, Ethernet connector, high voltage connector, electronics control unit connector and the like. Furthermore, this approach can be implemented in all products those have to consider electromagnetic compatibility (EMC). For example, cable isolation layers and shrinkage tubes may be provided with such materials, too.

[0013] According to one embodiment, the sealing member is composed of a ferrite mixture for dampening the electrical field strength. Thus, ferrite powder may be blended with a polymer for manufacturing an elastic sealing member for sealing the inner portion of the housing and the electrical wires against environmental influences.

[0014] The ferrite powder blended with polymer may be suitable for injection molding in order to enable a fast and reliable manufacturing process of the sealing member.

[0015] As an alternative or an addition, ferrite powder may be added to the materials of the housing, housing insert or to the wire fixture during their manufacturing process in order to improve corresponding EMC abilities of the said components.

[0016] In a further embodiment, the housing and/or the housing insert are composed of a thermoplastic or a thermoplastic compound comprising a higher permittivity and permeability than Polybutylene terephthalate material (PBT). Since the PBT is frequently used for manufacturing housings of connectors and other electrically insulating components, the EMC of such components may be improved by using materials with a higher permittivity and permeability.

[0017] By increasing the permittivity or permeability dielectric losses can be created inside the electrical connector. The dielectric losses can be adjusted with regard to the loss angle or a loss tangent.

[0018] In order to increase the dielectric losses, the components of the electric connector dielectric loss materials such as Barium Strontium Titanate (BST) ceramics can be utilized as addition to the materials for manufacturing.

[0019] In another embodiment, the housing and/or the housing insert are composed of a conductive plastic or conductive plastic compound. Thus, the components surrounding the electrical wires may act as a Faraday shield blocking electromagnetic fields. Preferably, the

parts composed of the conductive plastic may be grounded by electrical connection with corresponding electrical wires.

[0020] By using conductive plastics for EMI shielding, a uniform shielding capability may be provided. Moreover, the shielding can be applied to components with complex geometries. For example, the electrical connector may comprise an additional metal shield which may not necessarily cover the whole connector without affecting the EMI performance.

[0021] In a further embodiment, a ferrite core is disposed inside the housing or inside the housing insert for reducing the electrical field strength. Thus, it is possible to take advantage of the available space inside the inner portion of the housing or inside the housing insert.

[0022] Preferably, the ferrite core may be shaped to fit the available space. Moreover, dependent on the design of the electrical connector a plurality of ferrite cores may be disposed inside the connector housing and/or the housing insert. Thus, it is possible to provide individual ferrite cores for each electrical wire, for example.

[0023] In another embodiment, the ferrite core is fixed inside the housing or the housing insert by a circumferential portion of the wire fixture. The ferrite core may encompass the wire fixture at least partially.

[0024] The wire fixture may comprise structural shaping such as recesses or grooves for receiving the ferrite core positively. Thus, the ferrite core may be fixed inside the housing or the housing insert preventing impacts or damage to the ferrite core during assembly.

[0025] According to another embodiment, the housing comprises at least one latch disposed at an external face of the housing. Thus, the electrical connector may be plugged into a corresponding terminal and fixed inside the terminal preventing unintentional disconnection. Preferably, the housing insert is positively attached to the housing of the electrical connector. The wire fixture may be positively connected to the housing insert.

[0026] In a further embodiment, the housing insert comprises a length extending the housing single-sided against the plug direction of the electrical connector. Hence, the haptic of the electrical connector may be improved due to increased overall length. Moreover, since the length of the housing insert is increased, the housing insert may comprise additional space for receiving a ferrite core.

[0027] In another embodiment, the sealing member is a ferrite core. Application dependent the elastically formed sealing member may be replaced by a static ferrite mixture. Additionally or alternatively, the sealing member may comprise a lower thickness enabling additional space for arranging a ferrite core beside the sealing member.

[0028] The above-described characteristics, features and advantages of this invention and the way in which these are achieved will be more clearly comprehensible in connection with the description below of exemplary embodiments which are explained in detail in relation to the drawings, in which:

Fig. 1 shows an electrical connector according to one embodiment of the invention,

Fig. 2 shows a sectional view through the electrical connector shown in Fig. 1 and

Fig. 3 shows an electrical connector according to a further embodiment of the invention.

[0029] Fig. 1 shows an electric connector 1 according to one embodiment of the invention.

[0030] The electrical connector 1 comprises a housing 2 with a latch 4 disposed at one external face of the housing 2 for fixing the electrical connector 1 in a plugged state inside a terminal. For the sake of simplicity, the terminal is not shown in the figures.

[0031] Inside an inner portion of the housing 2 a housing insert 6 is positively arranged. Thus, the housing 2 and the insert 6 are forming one unit and a basic shape of the electrical connector 1. According to the shown embodiment, the housing insert 6 is extending the housing 6 opposite to a plug direction P.

[0032] On a side of the housing 2 opposite to the extending housing insert 6 a sealing member 8 is provided. The sealing member 8 is composed of an elastic material and is suitable for sealing the electrical wires 10 against dust and humidity.

[0033] The electrical wires 10 are disposed centrally inside a joint insulation 12 and are protruding the sealing member 8.

[0034] According the embodiment, the electrical connector 1 comprises a ferrite core 14 inside the housing insert 6. The ferrite core 14 comprises a shape corresponding to a basic shape of an inner portion of the housing insert 6. The shape of the ferrite core 14 is toroidal with four straight sections arranged in a rectangular manner.

[0035] In Fig. 2 a sectional view through the electrical connector 1 shown in Fig. 1 is illustrated. In particular, the arrangement of the ferrite core 14 inside the housing insert 6 is elucidated.

[0036] Furthermore, the wire fixture 16 is visible in the sectional view. The wire fixture 16 receives the electrical wires 10 and fixes the wires 10 relative to the housing insert 6. The wire fixture 16 comprises a groove 18 for inserting and positioning the ferrite core 14 inside the housing insert 6 and inside the housing 2.

[0037] Fig. 3 illustrates an electrical connector 1 according to a further embodiment of the invention. The electrical connector 1 comprises a sealing member 8 which is accomplished as a ferrite core 14. Thus, the sealing member 8 serves as a dampening material for the electrical field generated by the electrical wires 10.

[0038] The said sealing member 8, 14 may be provided for applications where it is not required to establish extensive sealing capabilities. The ferrite core sealing

member 8, 14 may act as a cover while improving EMI performance of the electrical connector 1.

[0039] Although the invention has been illustrated and described in detail by means of the preferred embodiments, the inventive electrical connector is not restricted by the disclosed examples, and other variations may be derived therefrom by a person skilled in the art without departing from the scope of protection of the invention.

Reference signs

[0040]

1	electrical connector
2	housing
4	latch of the housing
6	housing insert
8	sealing member + MATEnet ferrite cover (mixed ferrite powder with plastic)
10	electrical wires
12	insulation of wires
14	ferrite core
16	wire fixture
18	groove
P	plug direction

Claims

1. An electrical connector (1) comprising:

- a housing (2) for receiving and fixing a housing insert (6),
- the housing insert (6) with a wire fixture (16) disposed inside the housing insert (6),
- a sealing member (8) disposed at an end of the housing (2) in plug direction (P),
- at least one electrical wire (10) received and positioned by the wire fixture (16) and extending through the sealing member (8),

characterized in that at least one of the components (2, 6, 8, 16) of the electrical connector (1) comprises a material with properties for dampening an electrical field strength created by the at least one electrical wire (10).

2. Electrical connector according to claim 1, wherein the sealing member (8) is composed of a ferrite mixture for dampening the electrical field strength.

3. Electrical connector according to claim 1 or 2, wherein the housing (2) and/or the housing insert (6) are composed of a thermoplastic or a thermoplastic compound comprising a higher permittivity than Polybutylene terephthalate material.

4. Electrical connector according to anyone of the claims 1 to 3, wherein the housing (2) and/or the housing insert (6) are composed of a conductive plastic or conductive plastic compound.

5. Electrical connector according to anyone of the claims 1 to 4, wherein a ferrite core is disposed inside the housing (2) or inside the housing insert (6) for reducing the electrical field strength.

6. Electrical connector according to claim 5, wherein the ferrite core is fixed inside the housing (2) or the housing insert (6) by a circumferential portion (18) of the wire fixture (16).

7. Electrical connector according to anyone of the claims 1 to 6, wherein the housing (2) comprises at least one latch (4), disposed at an external face of the housing (2).

8. Electrical connector according to anyone of the claims 1 to 7, wherein the housing insert (6) comprises a length extending the housing (2) single-sided against the plug direction (P) of the electrical connector (1).

9. Electrical connector according to anyone of the claims 1 to 8, wherein the sealing member (8) is a ferrite core (14).

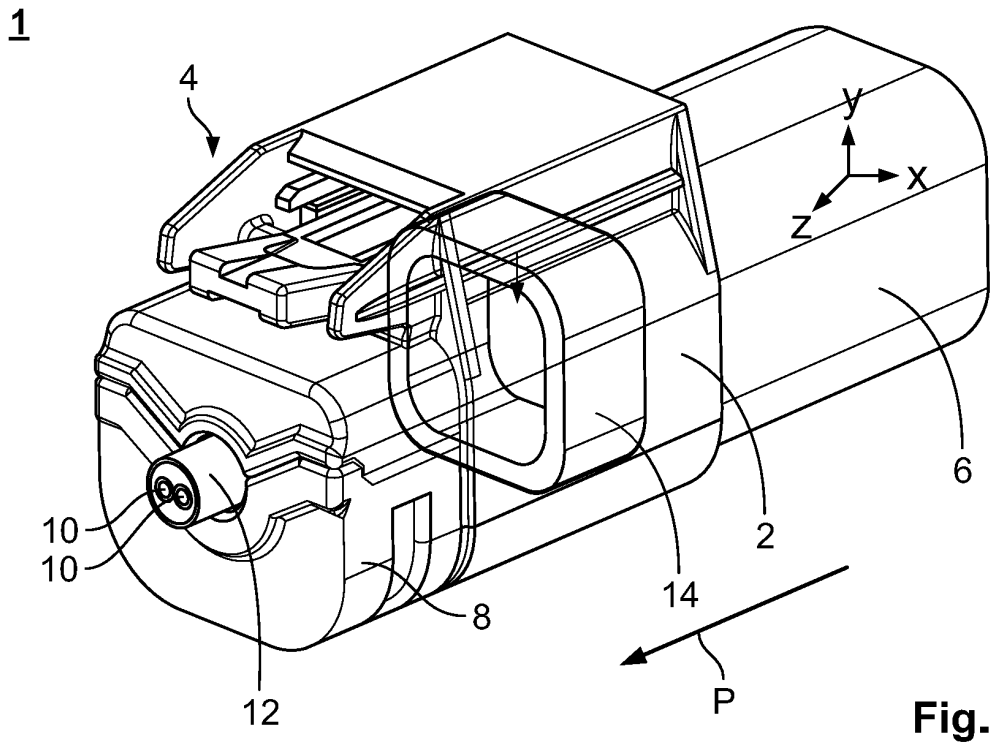

Fig. 1

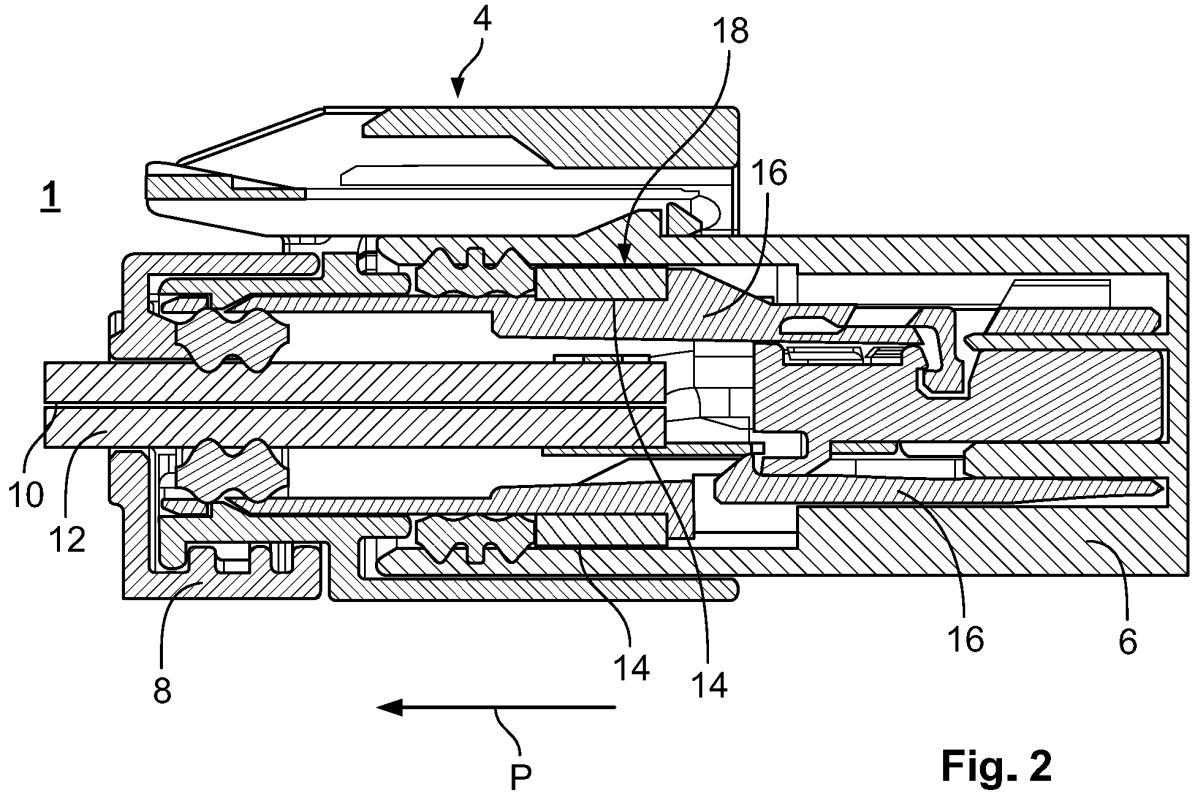

Fig. 2

Newly filed

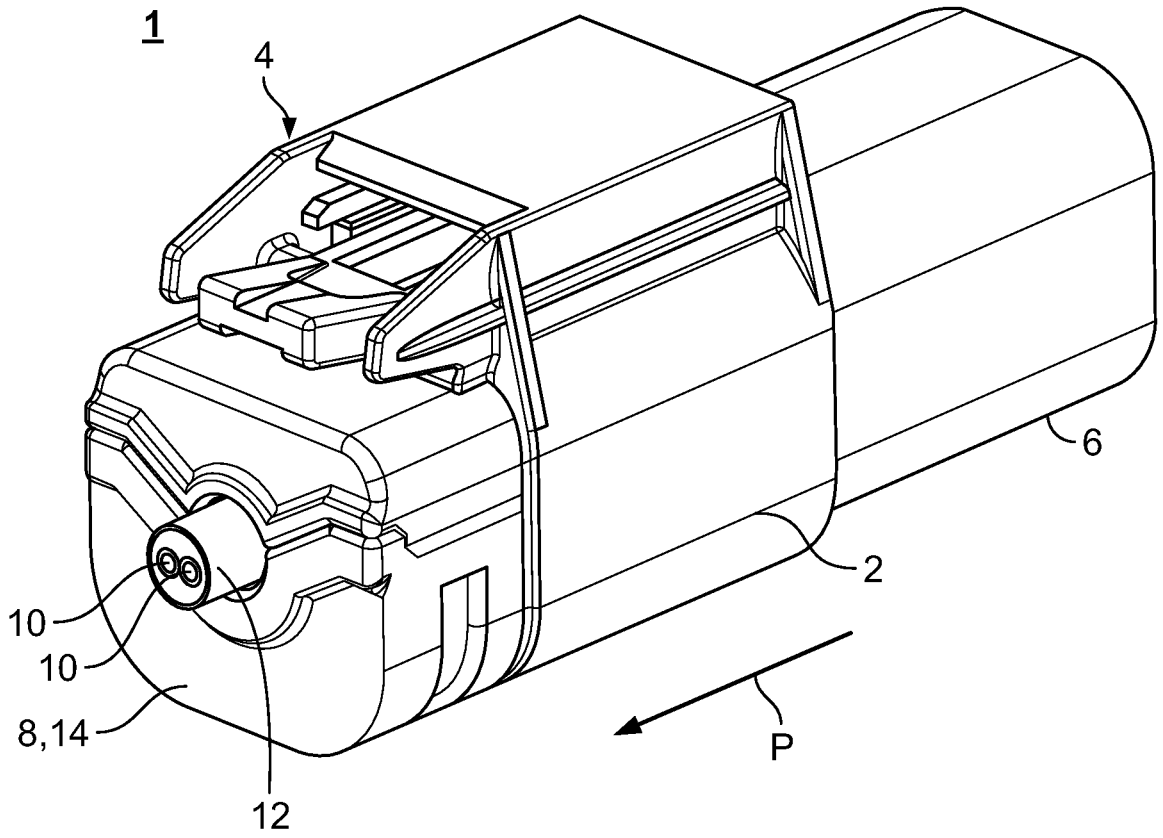

Fig. 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 18 16 7756

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 2011/061074 A1 (TYCO ELECTRONICS FRANCE SAS [FR]; PICAUD JEAN-PIERRE [FR]; DUPONT BRUN) 26 May 2011 (2011-05-26) * figures 1-8 * * claim 10 * -----	1,7-9 2-6	INV. H01R13/6599 H05K9/00 H01R13/506 ADD. H01R13/627 H01R13/422 H01R13/58
Y	US 2011/136350 A1 (PALLI CRAIG [US] ET AL) 9 June 2011 (2011-06-09) * paragraph [0331]; figures 1,2 * -----	2	
Y	US 2015/024629 A1 (SNADER ROBERT B [US] ET AL) 22 January 2015 (2015-01-22) * figures 1-6 * * paragraphs [0031], [0032] * -----	3	
Y	EP 2 254 199 A1 (TYCO ELECTRONICS LTD UK [GB]) 24 November 2010 (2010-11-24) * paragraph [0020]; figure 2 * -----	4	
Y	EP 1 253 680 A1 (J S T MFG CO LTD [JP]) 30 October 2002 (2002-10-30) * paragraph [0032]; figure 12 * -----	5,6	

TECHNICAL FIELDS SEARCHED (IPC)
H01R H05K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 September 2018	Ferreira, João

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 16 7756

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-09-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011061074 A1	26-05-2011	CN 102668252 A	12-09-2012
		EP 2504889 A1	03-10-2012
		FR 2953071 A1	27-05-2011
		JP 5682977 B2	11-03-2015
		JP 2013511800 A	04-04-2013
		US 2012231676 A1	13-09-2012
		WO 2011061074 A1	26-05-2011
US 2011136350 A1	09-06-2011	US 2009269943 A1	29-10-2009
		US 2011136350 A1	09-06-2011
		WO 2009082751 A2	02-07-2009
US 2015024629 A1	22-01-2015	NONE	
EP 2254199 A1	24-11-2010	AT 529921 T	15-11-2011
		AU 2010220195 A1	27-10-2011
		BR PI1012306 A2	27-03-2018
		CA 2753967 A1	10-09-2010
		CN 102341965 A	01-02-2012
		EP 2254199 A1	24-11-2010
		ES 2373078 T3	31-01-2012
		JP 5559213 B2	23-07-2014
		JP 2012519365 A	23-08-2012
		KR 20110124792 A	17-11-2011
		MY 149760 A	14-10-2013
		UA 106745 C2	10-10-2014
		US 2011308855 A1	22-12-2011
		WO 2010100467 A1	10-09-2010
EP 1253680 A1	30-10-2002	CN 1383236 A	04-12-2002
		EP 1253680 A1	30-10-2002
		HK 1050082 A1	15-09-2006
		JP 2002324638 A	08-11-2002
		KR 20020083142 A	01-11-2002
		TW I261957 B	11-09-2006
		US 2002160645 A1	31-10-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0742683 A1 **[0003]**