PRINTED CIRCUIT BOARD AND CONNECTOR ASSEMBLY

A printed circuit board (20), removably connectable or fixedly connected to an insulation piercing connector (10) attachable to an intermediate portion of an electrical cable (1), wherein said printed circuit board (21) comprises connecting means (22) suitably adapted to provide a mechanical and electrical coupling of the board (20) to the connector (10). Further a respective connector assembly comprising the printed circuit board (20) and the connector (10) is provided.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
PRINTED CIRCUIT BOARD AND CONNECTOR ASSEMBLY

The invention relates to a printed circuit board connectable to an insulation piercing connector according to claim 1 and to a connector assembly according to claim 6.

The demand for broadcasting capacities in telecommunication or data networks increases rapidly. Instead of installing additional signal-dedicated lines an alternative solution is to use existing power lines to carry information. The main advantage of these solutions is that a company may use their existing lines, which may even be attractive if there is no existing data or telecommunication network.

Common connecting points for power lines are sockets. Typically most of them are already in use. Therefore additional connecting points are required if the existing lines shall be used for carrying data signals. These additional connecting points can be realised by means of insulation piercing connectors being connectable to any accessible intermediate part of the power line.

Insulation piercing connectors as for example described in US 6,106,323 are typically used for tapping power from one cable to another. Such connectors may comprise an insulated clamping housing with at least one insulation piercing plate mounted therein, the housing having a first tooth or set of teeth on one side thereof interconnected with a second tooth or set of teeth on another side thereof, each side for connection to a cable. The piercing of an outer insulation layer of the cables is effected by bolting the connector clamping halves together. This is only an example, but the invention may use any other insulation piercing connector, even simpler models.

It is the object of the present invention to provide a printed circuit board and a connector assembly with which a compact and robust connection to an electrical cable is achieved.

This object is solved by the printed circuit board according to claim 1 and the connector assembly according to claim 6. Preferred embodiments are defined by various dependent claims.
According to the invention the printed circuit board is removeably connectable or 
fixedly connected to an insulation piercing connector attachable to an intermediate 
portion of an electrical cable, wherein said printed circuit board comprises connecting 
means suitably adapted to provide a mechanical and electrical coupling of the board to 
the connector. Thereby the insulation piercing connector known from the prior art or 
employed in existing systems can be used in combination with the printed circuit board. 
When the board is removeably connectable to the connector it can be easily exchanged 
if altered electrical requirements need to be met.

In a preferred embodiment of the invention, the connecting means is formed by an 
integral portion of the board. Such connecting means can be produced at low costs.

In another embodiment of the invention the connecting means is formed by a 
electrolytically conducting pin fixed to the board. The pin can be adapted in shape or size in 
order to fit to any of existing insulation piercing connectors. The shape of the pin can 
also be designed to prevent the dismantling of the board from the connector.

According to a further preferred embodiment of the invention, the board comprises 
electrical components adapted to extract a data signal conducted in the electrical cable. 
Hence, printed circuit board is an “active” device, able to e.g. filter and allow the 
passage of data signals conducted over the electrical cable.

The invention further provides a connector assembly comprising a printed circuit board 
according to one of the above embodiments and an insulation piercing connector.

The above and other features of the present invention will become clear from the below 
detailed description of preferred embodiments with reference to the following 
drawings, which show:

Fig. 1 a perspective view of the main components of an insulation piercing 
connector,
Fig. 2 a perspective view of a circuit board according to an embodiment of the present invention,

Fig. 3 a perspective view of a printed circuit board according to another embodiment of the invention,

5 Fig. 4 a perspective view of a connector assembly with a connector and the board coupled to each other, and

Fig. 5 a perspective view of the connector assembly of Fig. 4 in a completely connected state.

10 According to Fig. 1 the connector 10 comprises two housing parts 11 and 12, a sealing part 13, two piercing blades 14 and 18, a screw 15, a washer 16 and a shear head 17. The perspective view of Fig. 1 indicates how the connector’s components form the composite connector 10.

15 As illustrated in Fig 4, the housing parts are such formed that they provide a first opening for inserting a cable. More specifically, the housing parts each comprise a groove 55, 56 facing each other to form the first opening. A second opening for inserting connecting means 22 of a printed circuit board 21 shown in Fig. 2 is formed by corresponding grooves 57 and 58 together with a tunnel-like portion 59 of the sealing part 13. Housing parts 11 and 12 may be made of an electrically insulating material, such as injection moulding.

As further illustrated in Fig. 1, the piercing blades 14 and 18 are arranged in recesses 52 and 51 of the housing part 11 respectively. For piercing the insulation of the cable inserted in the first opening these blades comprise piercing tips 14A,18A, which are guided in the assembled state of the connector, through guiding holes 53 and 54 in the sealing part 13. The two piercing blades 14 and 18 are able to contact the inserted electrical cable using the piercing tips 14A,18A as well as the connecting means 22 of the printed circuit board 21 inserted into the second opening via contact elements 14B, 18B carried by the blades 14, 18.
The screw 15 and shear head 17 are used to connect the housing parts of the connector together and to provide a piercing force for piercing an insulation of the inserted cable by means of the piercing blades 14 and 18. The shear head 17 allows a control of the piercing force, thereby insuring the best electrical contact.

The piercing blades for example could be replaced by a single piercing blade, or even by separated piercing or contacting means for each opening connected via an internal electrical contact.

Fig. 2 illustrates in a perspective view a printed circuit board 21 according to an embodiment of the invention. It comprises connecting means 22 for providing a connection to an insulation piercing connector. In this embodiment the connecting means 22 is a pin fixed to the board 21 e.g. by soldering or any other means.

The board 21 further comprises electrical components such as a capacity 23 and a fuse 24. These components are adapted to extract or filter a data signal from the signal conducted by an electrical cable connected to the insulation piercing connector. Further illustrated in Fig. 2 is a protective housing 25 indicated by dotted lines. This housing can be obtained by overmoulding and could be waterproof. Finally, the printed circuit board 21 is connected to the data signal cable 2 which conducts the extracted data signal to a data or telecommunication terminal.

Fig. 3 illustrates another embodiment of the invention, wherein the printed circuit board 21 comprises connecting means 22 embodied by an integral portion of the printed circuit board 21. The board 21 further comprises the electrical components 23 and 24 and a proactive housing 25 similarly to the embodiment of Fig. 2.

In the above described embodiments the data signal cable 2 may be removably connected to the printed circuit board. Alternatively a wireless radio transmission circuit may provide the data signal. The electrical components 23 and 24 may not only be adapted to transform the voltage from a power line, filter power-related frequencies or provide protection against temporarily high voltages for example by means of the fuse 24, but could also comprise protocol conversion, protocol adapting or similar
circuits. Such circuits may be adapted to support any network-related or data signal-related functionality.

Fig. 4 in a perspective view illustrates a connector assembly comprising the insulating piercing connector 10 as illustrated in Fig. 1 attached to the printed circuit board 20 as illustrated in Fig. 2 or 3. The data signal cable 2 is connected to the printed circuit board 20 and the electrical cable 1 is insertable between the housing parts 11 and 12 of the insulation piercing connector 10. In such an arrangement the electrical cable 1 and the data cable 2 is aligned in parallel. The board 20 may be fixedly connected to the connector 10, to allow connecting the assembly to the cable 1 in a one step process.

Finally, Fig. 5 illustrates in a perspective view an assembled state of the connector assembly according to Fig. 4. The electrical cable 1 now is inserted into the connector 10. The electrical contact between conducting parts 72 of cable 1 and conducting parts 74 of data signal cable 2 has been realised by turning the shear head to fix the cable 1 in the respective opening of the connector 10 and to pierce the insulation 71 of the cable 1 by means of the piercing blades.
CLAIMS:

1. A printed circuit board (21), removeably connectable or fixedly connected to an insulation piercing connector (10) attachable to an intermediate portion of an electrical cable (1) characterized in that said printed circuit board (21) comprises connecting means (22) suitably adapted to provide a mechanical and electrical coupling of the board (21) to the connector (10).

2. The printed circuit board (21) according to claim 1 characterized in that the connecting means (22) is formed by an integral portion of the board (21).

3. The printed circuit board (21) according to claim 1 characterized in that the connecting means (22) is formed by an electrically conducting pin fixed to the board (21).

4. The printed circuit board (21) according to one of claims 1 to 3 characterized in that the board’s voltage resistivity is adapted to handle a supply voltage carried by the electrical cable (1) being a power line.

5. The printed circuit board (21) according to one of claims 1 to 4 characterized in that the board further comprises electrical components (23,24) adapted to extract a data signal conducted in the cable (1).

6. A connector assembly comprising a printed circuit board (21) according to one of claims 1 to 5 and an insulation piercing connector (10), said connector (10) comprising a first opening (55,56) for inserting the cable (1); a second opening (57,58) for inserting the connecting means (22) of the board (21);
and

insulation cutting or piercing means (14A,18A) for electrically contacting the cable (1) insertable in the first opening (55,56) by cutting or piercing through its insulation (71).

7. The connector assembly according to claim 6 characterized in that the insulation piercing connector (10) further comprises
   a housing of electrically insulating material (11,12), at least partially forming the first (55,56) and the second (57,58) opening;
   an internal electrical contact (14,18) connecting the inserted cable (1) with the inserted connecting means (22) of the board (21); and
   means (15,16,17) fixing the housing (11,12) to the cable (1).

8. The connector assembly according to claim 7 characterized in that
   the fixing means comprise a bolt (15), a shear head (17) and a washer (16) arranged to be mechanically connected through a central part of the housing (11,12), and
   the housing (11,12) comprises two parts arranged opposite to each other, wherein the first and second opening is formed by respective round grooves (55-58) in these parts of the housing (11,12).

9. The connector assembly according to claim 7 or 8 characterized in that the electrical contact (14,18) having the form of a blade comprises the piercing means (14A,18A)
10. and contacting means (14B,18B) for contacting the connecting means (22) of the board (21).

11. The connector assembly according to one of claims 7 to 9 characterized in that the electrical contact (14,18) is arranged in a corresponding recess (51,52) of the insulated housing (11).

12. The connector assembly according to one of claims 6 to 9 characterized in that the connector further comprises a sealing part (13) comprising a guiding hole (53,54)
guiding the piercing means (14A,18A) through the hole (53,54) to pierce the insulation (71) of the inserted cable (1).
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**IPC 7**  H01R4/24

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

**IPC 7**  H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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Further documents are listed in the continuation of box C.

| X        | Patent family members are listed in annex. |

* Special categories of cited documents:

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- **O** document referring to an oral disclosure, use, exhibition or other means
- **P** document published prior to the international filing date but later than the priority date claimed

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