(57) Abstract: The invention relates to an electrical connector (1), especially for data networks (16) via which data devices (18, 19, 20) are interconnected by means of data lines (7, 17), having at least two device contacts (5) on the data device side, having at least one mains contact (8) operating mode the data line side and having a transformer (13) connected between the at least two device contacts (5) and the at least one mains contact (8). In order to reduce the installation cost when the data network is operating at full capacity, according to the invention the transformer (13) combines an energy-data flow (D+E) present at the at least one mains contact (8) with an energy flow (E) at the one device contact (5) and with at least one data flow (D, D+E) at the other device contact (5).

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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.
Electrical Connector for Data and Energy Supply

The invention relates to an electrical connector, especially for a data network via which data devices are interconnected by means of data lines, having at least two device contacts on the data device side and at least one mains contact on the network side.

Such connectors are known from the prior art and are used for data transmission in network technology. Modern data networks are used for connection of different data devices, such as computers, telephones, data servers and printers in, for example, an office building. Comparable with a power supply network, the data lines are laid over long distances, concealed from external view, in walls, false ceilings or cable ducts. At arbitrary points in the building, connection points are provided, for example, in the form of power outlets in the walls or in the floor, at which the data devices can be connected to the data network. The data lines for several data devices are brought together at node points. The node points are connected to a data device serving as data source, to which the remaining data devices have access.

A large proportion of the devices connected to the data network, such as printers and computers, are equipped with their own power supply. Many small data devices nevertheless have to be supplied with power via the data network itself or via mains power lines. Such data devices include, for example, cameras, card readers and keyboards. These data devices are known as passive data devices because they do not have a power supply of their own.

The passive data devices are connected to the data network via standardised connectors having at least two device contacts, the data transmission in the form of a data flow running via one device contact and a power transfer in the form of an energy flow running via the other device contact. Data is exchanged between the data device and the data network by the data flow and the data device is supplied with power by the energy flow. The energy flow is transferred here in the form of a power supply signal, which can be configured as a direct current or
alternating current signal.

Since the power supply is effected via the data network, the data devices need no longer be connected to the mains supply. The passive data devices can therefore be used flexibly, independently of the mains supply, wherever a connecting point to the data network exists. The effect of the increased use of passive data devices has been, however, that the data network quickly comes up against its capacity limits. In order in this case to increase the capacity of the data network, there is often no alternative but to lay new network lines at great expense. In the case of the technologies used up till now, it is precisely the additional power supply via the data lines that can lead to existing networks rapidly being used to full capacity, since the power supply is effected partly via internal lines.

It is therefore an object of the present invention to improve the electrical connector mentioned in the introduction so that the capacity of an existing network can be utilized more effectively.

That object is achieved in accordance with the invention in that the connector has a transformer integrated between the at least two device contacts and the at least one mains contact, which transformer combines an energy-data flow present at the at least one mains contact with an energy flow at the one device contact and with at least one data flow at the other device contact.

This solution has the advantage that no separate data lines and no separate conductors in the data line are needed, rather, one conductor of the data line simultaneously transmits a data signal and supplies the data device with power. This enables the number of conductors required in the data line to be reduced, and hence also the material costs and installation costs when installing the data network.

The particular advantage of this solution is that it is possible to use old, existing data networks, for example, ethernet networks, in which for reasons associated with capacity there are insufficient free conductors in the network lines to transmit a separate energy flow without additional modification measures, such as the replacement of the network cables or the laying of new data lines. In this case, the conductors of the existing data lines previously used for transmitting the data
flow are utilised to transfer the combined energy-data flow, that is, simultaneously for energy supply and data transfer. The old connectors merely have to be exchanged for the connectors according to the invention, the data lines remain unchanged.

The electrical connector according to the invention can be further modified by different independent constructions, each advantageous in their own right. These constructions and the respective advantages associated with the constructions will be described briefly in the following.

In one advantageous form, the transformer can be of bi-directional construction. Bi-directionality is especially possible when a combined energy-data flow arriving at the mains contact is converted by the transformer into an energy flow at the one device contact and a data flow at the other device contact; at the same time, the transformer converts an energy flow arriving at the one device contact and a data flow arriving at the other device contact into a combined energy-data flow at the mains contact. This has the advantage that the same connector can be used both for superimposing the energy flow and the data flow in the direction from the data device to the network and for splitting the combined energy-data flow into the energy flow and the data flow in the direction from network to data device. The same connector can consequently be used without modification or other intervention both at connecting points and at node points.

Furthermore, the one device contact, to which the energy flow is routed, can be configured as a power contact, at which the data signal is filtered out and essentially only the power supply signal is present. By this measure, the device to be supplied with energy does not require a filter in order to filter out the power supply signal. The combined data-energy flow can be routed substantially unchanged to the other device contact.

In an advantageous development, the actual socket of the connector can be constructed with its device contacts in an adapter held interchangeably on the connector. This has the advantage that devices having different plug standards can be attached to the connector without the connector itself having to be changed. In
order, for example, for a connector previously used as ethernet outlet to be used as a USB or ISDN outlet, in this construction only the adapter has to be exchanged. In the case of data networks, it is possible in particular to construct the adapter as an RJ45-socket, where the data transfer is effected via Cat 3 or Cat 5 cables.

In order to exchange the transformer with the adapter, the transformer can be integrated in the adapter.

In an advantageous development, the transformer can comprise a multiplexer, in order to superimpose the data flow on the energy flow. In order to separate the energy flow from the combined energy-data flow, a demultiplexer can be integrated in the transformer. With a bi-directional construction of the transformer, both a multiplexer and a demultiplexer can be integrated in the connector.

The connector can be used as a socket outlet for mounting on walls or floors, as a surface-mounted or flush socket outlet or as an insert for edge connectors in patch panels.

The invention is described hereinafter by way of example with reference to the accompanying drawings. The different features can be combined independently of one another, as already stated above in connection with the individual advantageous constructions.

In the drawings:

Fig. 1 shows schematically in an exploded view an embodiment of the connector according to the invention;

Fig. 2 shows a circuit diagram of an embodiment of a connector according to the invention in a schematic representation;

Fig. 3 shows a circuit diagram of another embodiment in a schematic representation.

Fig. 1 shows an electrical connector 1, which is in the form of a socket outlet mountable by means of a mount 3 on a substrate 2, such as a wall or a floor or a
patch panel. The connector 1 comprises a device-side socket 4 with device contacts 5, to which data devices such as computers, keyboards, card readers, telephones and cameras can be connected via usually standardised plugs 6 and the data line 7 connected thereto.

5 Using network-side mains contacts 8, the connector 1 can be connected up to a data network. The mains contacts 8, as illustrated in Fig. 1, can be constructed on a rear connector 9, which can be inserted into a network socket 10.

The connector 1 is part of an adapter system, so that one and the same connector 1 can be used without structural modifications as a surface-mounted socket outlet, as a flush socket outlet and as an insert for edge connectors and plug panels and in switches. The individual usage forms merely require different mounts 3.

The versatility of the system can be further increased if the socket 4 itself is constructed as part of an adapter 11 interchangeably mounted in the connector. If a data device using a different plug standard is to be connected up using this construction, then simply the corresponding adapter part has to be used. For example, by exchanging the adapter 11, an ethernet socket can be exchanged for an ISDN socket or a USB socket or a firewire socket.

Exchange of the adapter 11 is achieved by virtue of the fact that, independently of the plug form used, the adapter is provided with a standardised housing and a standardised system connector 12, which is inserted into the connector 1. The housing and the connector 12 are always of the same construction, regardless of the form of the socket in the case of the different adapters. In order to retain the adapter 11 in the connector 1 so that it is resistant to tensile stress, the adapter 11 is provided with retaining means 13', which can comprise catches, clips or screw connections. The retaining means 13' prevent the socket 4 from becoming detached from the connector 1 when the plug 6 is removed from the socket 4.

With reference to the embodiment of Fig. 2, the wiring scheme of a connector 1 according to the invention will now be explained; elements whose
function and/or construction has already been described in connection with the embodiment of Fig. 1 are provided with the same reference numerals as in Fig. 1.

A transformer 13 connected between the device contacts 5 and the mains contacts 8 is integrated in the electrical connector 1. In particular, the transformer 13 can be in the form of an exchangeable adapter 11. The transformer 13 can be operated in two different ways:

In the first mode of operation, a pure data signal is fed from a data device, such as a server, connected to the connector 1, via data contacts 14, which form part of the device contacts 5, into the network and is received by the network. As can be seen in Fig. 2, the exchange of data can take place, for example, via a total of four data contacts 14. The data signals are routed from the data contacts 14 via the transformer 13 substantially unchanged to the four mains contacts 8 and from there into the data network. The flow of data signals out of and into the mains via the connector 1 is called the data flow in the following description. In Fig. 2, the data flow is represented symbolically with an arrow D. In the embodiment of Fig. 2, the number of data contacts 14 corresponds to the number of mains contacts 8.

In order to supply additional data devices in the network with power via the network cable, electrical energy is routed into the network cable from the device that is connected to the device contacts 5. The flow of energy through the connector 1 is called energy flow E below, and in represented in Fig. 2 by way of example by an arrow E. Analogously to the data flow and the data signal, the energy flow is generated by a power supply signal, for example, a direct current signal or an alternating current signal. Energy flows having relatively small ratings in the range between 10 and 20 watts are usually sufficient for the power supply of modern data devices. In particular, the power supply signal can originate from a direct current source having a potential of ±57 volts.

The power supply signal is routed from the device serving as energy source via device contacts 5 configured as power contacts 15 to the connector 1 and in the transformer 13 is overlaid with the data signals, so that a superimposed data-energy signal is present at all mains contacts 8. The data flow D and the energy flow E are
thus combined in the first mode of operation of the transformer 13 into a superimposed energy-data flow, rendered in Fig. 2 by an arrow marked E+D.

As can further be seen in Fig. 2, a total of four power contacts 15 are used, which in the socket 4 or adapter 11 are of separate electrical construction from the data contacts 14 and are electrically connected with the data contacts 14 only via the transformer 13. Two power contacts at a time can be directly electrically connected with one another before the transformer 13, so that the same power supply signal is present at two power contacts 15 at a time. When the power supply is effected by means of direct current, a negative voltage of -57 volts is present at one pair of power contacts and a voltage of +57 volts is present at the other pair of power contacts. The signals at the power contacts 15 are used only for power supply and have no or at any rate very small proportions of data signal.

In the embodiment shown in Fig. 2, the power supply signals at respective pairs of interconnected power contacts have the data signals of two data contacts superimposed on them. A superimposed data-power supply signal D+E is consequently present at all four mains contacts 8, so that both power supply and data transfer to an RJ45 socket can be effected via a standard Cat 5 cable.

Because the power supply signals and data signals have been superimposed in the transformer 13, it is possible to route both an energy flow E and a data flow D via the same number of mains contacts 8 as was previously used purely for data transfer. The capacity of the existing network cables can consequently be utilised both for transfer of data signals and for power supply.

The transformer 13 can comprise in particular a multiplexer. The power supply to the transformer 13 can be effected directly via the power supply signal.

In the second mode of operation, effective in the reverse direction to the first mode of operation, the connector 1 can be used to split the combined data-energy flow D+E to the mains contacts 8 in the transformer 13, and to provide a power supply E at the power contacts 15 and a data flow D at the data contacts 14. This second mode of operation is represented symbolically in Fig. 2 by the second dot-dash arrowhead of the arrows D, D and D+E.
For the second mode of operation, the transformer 13 can be in the form of a demultiplexer, which is of corresponding construction to the multiplexer at the point of introduction of the power supply signal into the network and which demultiplexes the superimposed data-power supply signal. Instead of introducing power into the data network and instead of diverting power from the data network, that is, where a passive terminal device is involved, different respective unidirectional constructions of transformers 13, corresponding to the two different modes of operation, can be used, each permitting energy flow in one direction only, either from the device contacts 5 to the mains contacts 8 (solid-line arrow head in Fig. 2) or in the reverse direction (dot-dash arrow head in Fig. 2).

More advantageous, however is the use of bi-directional transformers 13, which function in both modes of operation independently of the direction of the energy flow. Both a multiplexer and a demultiplexer can be integrated in such a bi-directional transformer 13, and can be operated both in the first and in the second mode of operation.

Fig. 3 is a schematic illustration of a data network, the same reference numerals as used in the preceding embodiments being used for elements whose construction and/or function are/is already known from the two preceding embodiments.

The data network 16 is equipped, for example, with an RJ45 double-plug system in the connectors 1 and permits both conventional data transfer via the conventional, pre-installed Cat 5 network cable 17 having eight conductors and power supply to passive data devices at two independent double-plug socket outlets per mains cable 17.
This is explained below from the example of securing a building access by means of a card reader 18 with integrated keypad and a camera 19 as peripheral devices.

The card reader 18 and the camera 19 exchange data with a central computer 20. The card reader 18 and the camera 19 have no power supply of their own and are therefore supplied with power from the correspondingly equipped central computer 20 via the connector 1 and the mains cable 17. The two peripheral devices 18, 19 have different standards for power supply, both of which are handled by the transformer 13, as explained below.

The card reader 18 is thus connected to just four device contacts 5, in particular the four data contacts 14, and by means of a combined energy-data flow D+E is supplied with both energy and data via these four device contacts. The energy flow E split off by the transformer 13 in the peripheral device-side connector 1 remains unused. The energy flow E is not split from the data flow D until inside the card reader 18.

The combined data-energy flow D+E is applied by the central computer 20 to the data contacts 14, and the energy contacts 15 remain unused.

The transformer 13 in the connector 1 interposed on the computer side is constructed so that it always transfers the data signal unchanged to the data contacts 15, irrespective of the properties of the signal. If as a consequence a combined energy-data signal is routed via the data contacts 14 to the transformer 13, then this is fed into the mains cable 17 and is made available, unchanged, at the data contacts by the peripheral device-side connector 1, without being split into the power supply signal E and the data signal D.

The camera 19 on the other hand operates according to the standard as described above for the embodiment of Fig. 2: an energy flow is routed from the computer 20 to the power contacts 15 and a separate data flow D is routed to the data contacts 14. In the transformer 13 of the connector 1, the data flow D is then superimposed on the energy flow E and the combined energy-data flow D+E is routed through the network cable 17. The transformer 13 on the peripheral device side splits the energy flow E from the data flow D again and transfers a power

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supply signal E to the camera 19 and, separated therefrom, a data signal D, as represented symbolically by the separate arrows D and E.

As is apparent from the embodiment of Fig. 3, using a connector 1 according to the invention with transformer 13 it is possible for two peripheral devices conforming to two different standards to be supplied with energy and data via conventional mains cables 17, namely, firstly with an energy flow E and a data flow D separated at the connector 1 on peripheral device side, as explained by the example of the camera 19. Secondly, a combined energy-data signal D+E can be provided simultaneously at the data contacts of the connector 1 on the peripheral device side, as explained by the example of the card reader 18. Each of the two standards can, of course, be used at each of the two plugs of the connector.

By a simple modification, the transformer 13 can designed to comply with the two standards described by the example of the card reader 18 on the one hand and the camera 19 on the other hand: for that purpose, the transformer 13 merely has to feed the signal at the data contacts 14 unchanged into the mains cable 17 and output it again at the opposite side, unchanged, to the data contacts 14, irrespective of whether a signal is present at the power contacts 15 or not. In this way, a combined energy-data signal D+E fed in at the data contacts 14 is output, unchanged, on the peripheral device side at the data contacts 14 as a combined energy-data signal. At the same time, the energy signal E is split off by the peripheral device-side transformer 13 and made available at the energy contacts 15.

Peripheral devices other than a card reader 18 and a camera 19 can also be used. Other modifications are likewise possible, for example, the camera can be operated via USB plugs and not using the RJ45 plugs shown. As already explained with reference to the embodiment of Fig. 1, for that purposes the corresponding adapter 11 merely has to be inserted in the connector 1.
Claims

1. An electrical connector (1), especially for data networks via which data devices (18, 19, 20) are interconnected by means of data lines (7, 17), having at least two device contacts (5) on the device side and at least one mains contact (8) on the data line side, characterised in that the connector (1) has a transformer integrated between the at least two device contacts (5) and the at least one mains contact (8), which transformer combines an energy-data flow (D+E) present at the at least one mains contact with an energy flow (E) at the one device contact (15) and with at least one data flow (D) at the other device contact (14).

2. An electrical connector (1) according to claim 1, characterised in that the transformer (13) is of bi-directional construction and is designed both to convert a combined energy-data flow (D+E) arriving at the mains contact (8) into an energy flow (E) at the one device contact (15) and at least one data flow (D) at the other device contact (14) and to convert an energy flow arriving at the one device contact (15) and a data flow (D) arriving at the other device contact (14) into a combined energy-data flow (D+E) at the mains contact (8).

3. An electrical connector (1) according to claim 1 or 2, characterised in that the connector (1) has at least one socket (4).

4. An electrical connector (1) according to claim 3, characterised in that the transformer (13) is integrated in the adapter (11).

5. An electrical connector (1) according to claim 1 or 2, characterised in that the electrical connector (1) has two RJ45 sockets (4).

6. An electrical connector (1) according to any one of the preceding claims, characterised in that the transformer (13) comprises a multiplexer and/or a
demultiplexer.

7. An electrical connector (1) according to any one of the preceding claims, characterised in that the number of power supply contacts (15) is at most half the number of device contacts (5).

8. An electrical connector (1) according to any one of the preceding claims, characterised in that the transformer (13) is designed to output a data signal (D) or combined energy-data signal (D+E) present at the one device contact (14) unchanged at the at least one mains contact (8).

9. Data network (16) having at least two connectors (1), which are connected by a network cable (17), characterised in that the connectors (1) are constructed in accordance with one of the preceding claims.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01R13/66 H04B3/56

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 H04B

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

Electronic database consulted during the international search (name of database and, where possible, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of box C. Patent family members are listed in annex.

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