



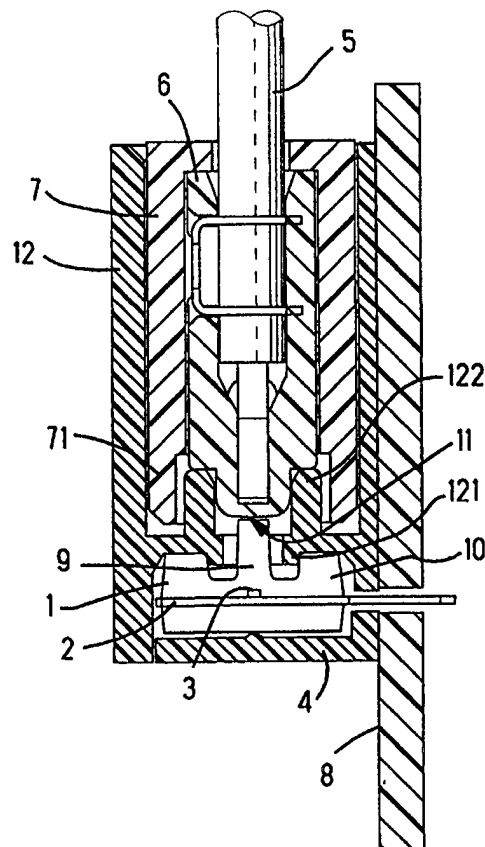
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification <sup>6</sup> : G02B 6/42, H01L 33/00, 31/00</p>	A1	<p>(11) International Publication Number: <b>WO 98/15866</b></p> <p>(43) International Publication Date: 16 April 1998 (16.04.98)</p>
<p>(21) International Application Number: PCT/IB97/01229</p> <p>(22) International Filing Date: 7 October 1997 (07.10.97)</p> <p>(30) Priority Data: 96116253.4 10 October 1996 (10.10.96) EP (34) Countries for which the regional or international application was filed: DE et al.</p> <p>(71) Applicant (for all designated States except US): THE WHITAKER CORPORATION [US/US]; Suite 450, 4550 New Linden Hill Road, Wilmington, DE 19808 (US).</p> <p>(72) Inventor; and (75) Inventor/Applicant (for US only): GASZCZAK, Richard [DE/DE]; Riedstrasse 18, D-64625 Bensheim (DE).</p> <p>(74) Agents: HEINZ-SCHAEFER, Marion et al.; AMP International Enterprises Ltd., AMPèrstrasse 3, CH-9323 Steinach (CH).</p>		<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).</p> <p><b>Published</b> With international search report.</p>

(54) Title: OPTICAL-FIBRE TRANSMITTER AND/OR RECEIVER MODULE, AND AN ACTIVE OPTO-ELECTRONIC ELEMENT

## (57) Abstract

An optical-fibre transmitter and/or receiver module (1) is specified which has an active opto-electronic element (3) which is connected to a connecting frame (2) and is embedded in a housing (10) made from a transparent material. The module further has an optical-fibre connector with an external connector housing (7) and an inner connector part (6) which has an optical-fibre end face (11). The housing (10) of the opto-electronic element (3) has an essentially cylindrical optical-guide section (9) which is arranged over the active surface of the opto-electronic element (3), projects beyond the dimensions of the housing (10), and is connected directly or via a defined air gap to the optical-fibre end face (11).



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OPTICAL-FIBRE TRANSMITTER AND/OR RECEIVER MODULE, AND AN  
ACTIVE OPTO-ELECTRONIC ELEMENT

The invention relates to an optical-fibre  
5 transmitter and/or receiver module having an active opto-  
electronic element which is connected to a connecting  
frame and is embedded in a housing made from a  
transparent material, and having an optical-fibre  
connector with an external connector housing and a  
10 connector inner part which has an optical-fibre end face.  
The invention further relates to an active opto-  
electronic component having a housing which encloses the  
element and is made from a transparent material, and  
having a connecting frame.

15 In optical transmission systems, there are optical-  
fibre transmitter or receiver modules which serve the  
purpose of coupling light out of an optical fibre onto a  
receiver element (for example a photodiode or photo  
transistor), and converting it into an electrical signal  
or, correspondingly, of converting an electrical signal  
20 and launching light into an optical fibre by means of a  
transmitter element (for example, LED or laser diode).  
Such modules correspondingly comprise optical-fibre ends  
and one or more transmitters and/or one or more  
25 receivers.

Such an arrangement is disclosed, for example, in  
EP 113 991 A1. There, an opto-electronic element is  
located in a housing which has an opening for the purpose  
of accepting an optical-fibre connector through said  
30 opening. The opto-electronic element is encapsulated by a  
transparent material, and the latter has a depression  
with a lens into which the end of the optical fibre has  
to be introduced. It is therefore necessary for the fibre  
end in the front region to project from the connector, or

for the connector to be matched to the optical element, for example by providing a connector housing whose collar surrounds the optical element at least partially.

An optical-fibre transmitter or receiver module is likewise disclosed in US 5,243,678, a transmitter and a receiver being arranged next to one another in the module, and the housings, made from transparent material, of these opto-electronic components in each case having a retarded surface of the housings, with which an optical fibre makes contact. The retarded surface of the housings in this case has a nose, and the corresponding connector end has a depression, as a result of which it is possible to achieve a particularly accurate coupling.

It is the object of the invention to specify a transmitter and/or receiver module and an active opto-electronic element which render it possible, on the one hand, for the sensitive optical contact surface not to have to be exposed at its end region and, on the other hand, for good coupling to be achieved.

The object is achieved with reference to the module by means of an arrangement having the features of Patent Claim 1, and with reference to the element by means of an arrangement having the features of Patent Claim 8.

Advantageous developments are specified in each case in the subclaims.

It is particularly advantageous that for the purpose of coupling the optical-fibre end to the opto-electronic component it is no longer necessary for the optical fibre to project from the connector in order to engage in a depression in the injection-coating of the opto-electronic element. Instead of this, the housing of the opto-electronic element has an optical-guide section to which the end face of an optical fibre can be coupled

very easily. Here, this coupling is independent of the nature of the optical-fibre connector.

It is particularly advantageous when the connector housing of the optical-fibre connector has a  
5 circumferential collar which projects in the plug-in direction beyond the optical-fibre end face, and thus protects the sensitive end face of the optical fibre. In this case, the collar need not be configured such that it accepts the entire housing of the opto-electronic  
10 element, but it need only accept the optical fibre which is fastened to this housing or is constructed in one piece therewith.

An exemplary embodiment of the invention is described with the aid of the figures, in which:

15 Figure 1 shows a partial cross-section through an arrangement according to the invention, which is fastened to a printed circuit board, and

Figure 2 shows a partial cross-section through the same arrangement and at right angles to the first partial  
20 cross-section.

Figure 1 shows a printed circuit board 8 on which an enveloping housing 12 is mounted. Located at one end of the enveloping housing 12 is a printed circuit board connection 4 which carries an active opto-electronic  
25 element 3 surrounded by a housing 10. The active opto-electronic element 3 has a connecting frame 2 which projects with corresponding connections through the printed circuit board 8. The housing 10 surrounds the active opto-electronic element 3 completely. It consists  
30 of a transparent material, for example an epoxy resin. In the direction of the optical axis, the housing 10 has an optical-guide section 9 which is produced from the same material as the housing 10 and permits the light to be guided away from or to the opto-electronic element 3.

The figure also shows an optical fibre 5 which has a plastic cladding and is fastened in an optical-fibre connector consisting of an inner connector part 6 and a connector housing 7. The optical-fibre end face 11 can be arranged directly on the end face of the optical-guide section 9. This direct coupling leads to a transition from the optical fibre to the housing 10 of the opto-electronic element which exhibits low attenuation. Supporting the shoulder of the connector inner part 6 on the annular centring housing, acting as a seal, of the enveloping housing 12 likewise renders a defined contact gap possible. Scratching of the optical contact surfaces in the event of vibration can thereby be excluded, by accepting a slight worsening of the transition attenuation. A light beam is illustrated in the figure as an arrow.

Because of the special design of the housing 10 with the optical-guide section 9, it can be achieved that the optical-fibre end face 11 is arranged set back behind a collar 71 of the connector housing 7. The collar 71 can thus protect the sensitive optical-fibre end face 11.

Essentially the same arrangement is represented again in a different section in Figure 2, it also being clearly visible here that the optical-fibre end face 11 of the optical fibre 5 is coupled directly to the optical-guide section 9 of the housing 10. The housing 10 can be centred on the enveloping housing 12 by means of a cylindrical collar 121 thereon. The plug inner part can likewise be adjusted on the collar 122. Good adjustment of the housing 10 relative to the optical-fibre connector is thereby ensured.

Because of this special design, low-attenuation coupling is possible, and it is possible to use optical-fibre connectors which have collars which project beyond

the optical-fibre end face and thus constitute a guard for this sensitive end face.

CLAIMS

1. Optical-fibre transmitter and/or receiver module (1)  
- having an active opto-electronic element (3)  
5 which is connected to a connecting frame (2) and  
is embedded in a housing (10) made from a  
transparent material, and  
- having an optical-fibre connector with an  
external connector housing (7) and an inner  
10 connector part (6) which has an optical-fibre end  
face (11),  
characterized in that the housing (10) of the opto-  
electronic element (3) has an essentially cylindrical  
optical-guide section (9) which is arranged over the  
15 active surface of the opto-electronic element (3),  
projects beyond the dimensions of the housing (10), and  
is connected to the optical-fibre end face (11) for the  
purpose of launching light.
- 20 2. Optical-fibre transmitter and/or receiver module  
according to Claim 1, characterized in that the connector  
housing (7) of the optical-fibre connector has on the  
plug-in side a circumferential collar (71) which projects  
beyond the optical-fibre end face (11) in the plug-in  
25 direction.
3. Optical-fibre transmitter and/or receiver module  
according to one of Claims 1 or 2, characterized in that  
a printed circuit board connection (4) is provided by  
30 means of which the active opto-electronic element (3)  
with a housing (10) and connecting frame (2) can be  
mounted on a printed circuit board (8).



4. Optical-fibre transmitter and/or receiver module according to one of Claims 1 to 3, characterized in that an enveloping housing (12) is provided which has means for the accommodation and relative adjustment of the optical-fibre connector and housing (10) with an opto-electronic element (3).
5. Optical-fibre transmitter and/or receiver module according to one of Claims 1 to 4, characterized in that the optical-fibre end face (11) is directly connected to the optical-guide section (9).
6. Optical-fibre transmitter and/or receiver module according to one of Claims 1 to 4, characterized in that the optical-guide end face (11) is connected to the optical-fibre section (9) via a defined gap.
7. Optical-fibre transmitter and/or receiver module according to Claim 6, characterized in that the gap is filled with an index-matching gel.
8. Active opto-electronic element (3) having a housing which encloses the element (3) and is made from a transparent material, and having a connecting frame (2), characterized in that provision is made for an essentially cylindrical optical-guide section (9) which projects beyond the dimensions of the housing (10) and is arranged over the active surface of the opto-electronic element (3) in such a way that an optical fibre can be coupled to the element (3) via the optical-guide section (9).
9. Active opto-electronic element according to Claim 8, characterized in that the housing (10) consists of epoxy

resin, and the element (3) is potted therein.

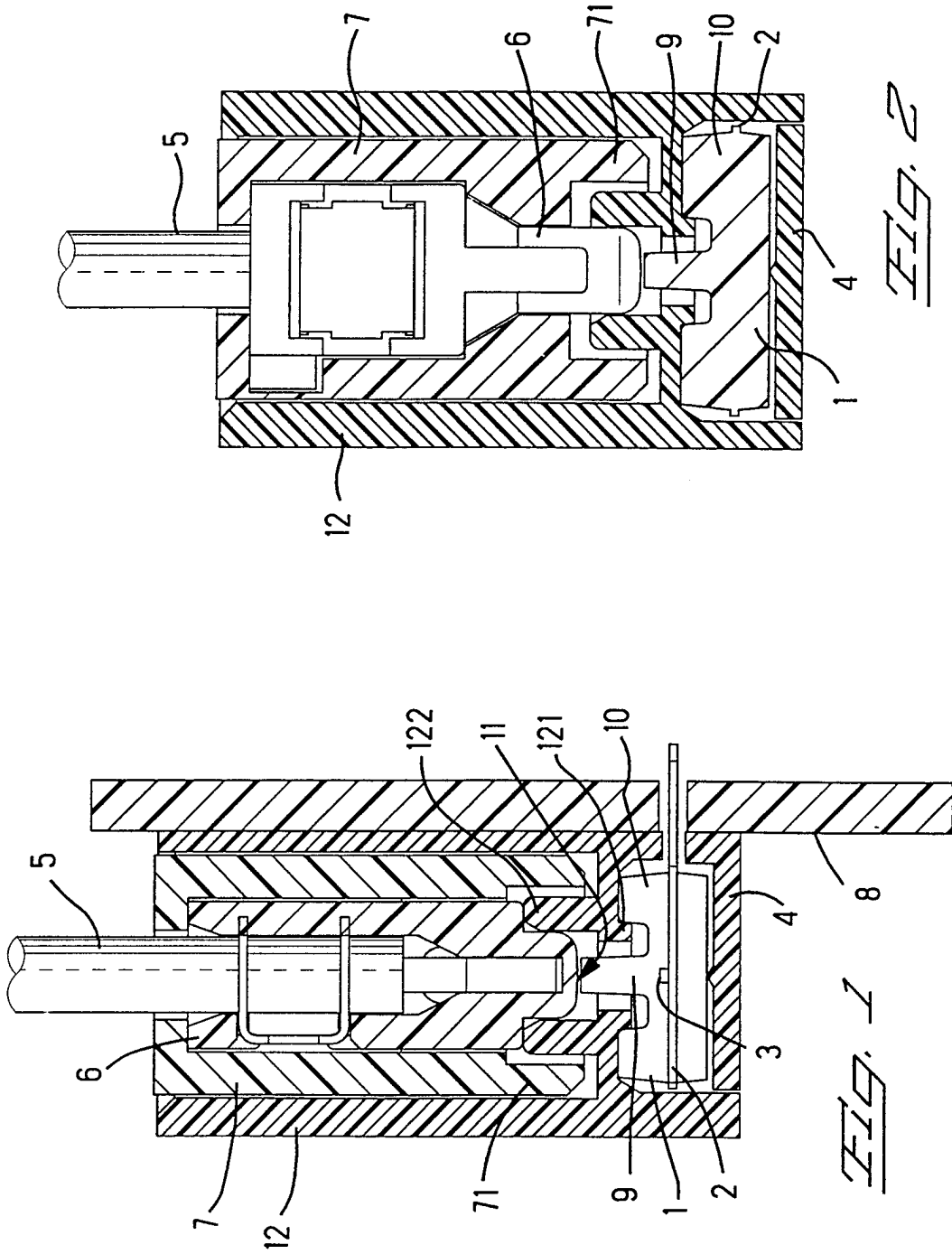


FIG. 2

FIG. 1

INTERNATIONAL SEARCH REPORT

International Application No  
PCT/IB 97/01229

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 G02B6/42 H01L33/00 H01L31/00

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 6 G02B H01L

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)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 186 996 A (BENDIKSEN LEONARD F ET AL) 5 February 1980 see column 4, line 57 - line 68 see column 5, line 1 - line 59 see figures 4,5	1
A	* idem *	2, 3, 5, 6, 8
Y	GB 2 119 959 A (BICC PLC) 23 November 1983 see the whole document	1
X	* idem *	8
A	* idem *	9
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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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Date of the actual completion of the international search <b>18 December 1997</b>	Date of mailing of the international search report <b>15/01/1998</b>
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## INTERNATIONAL SEARCH REPORT

International Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 25 42 095 A (LICENTIA GMBH) 24 March 1977 see page 10, line 12 - line 19 see page 11 see figures 1,2 ----	8
X	US 4 433 898 A (NASIRI SAEED) 28 February 1984 see column 3, line 49 - line 68 see column 4 - column 5 see figures ----	8
A	GB 1 456 394 A (BICC LTD) 24 November 1976 see the whole document ----	1,4,5,8
A	AU 510 340 B (DEUTSCH CO ELEC COMP) 19 June 1980 see page 20, line 24 - line 30 see page 21 - page 23 see figure 16 ----	1,7,8
A	GB 2 143 651 A (MOLEX INC) 13 February 1985 see the whole document ----	1,3,4,8
A	EP 0 053 482 A (TOKYO SHIBAURA ELECTRIC CO) 9 June 1982 see page 3, line 5 - line 37 see page 4, line 1 - line 37 see page 5, line 1 - line 36 see figures -----	1,8,9

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IB 97/01229

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4186996 A	05-02-80	CA 1119858 A EP 0009330 A JP 1445951 C JP 55045095 A JP 62044243 B	16-03-82 02-04-80 30-06-88 29-03-80 18-09-87
GB 2119959 A	23-11-83	US 4530566 A	23-07-85
DE 2542095 A	24-03-77	US 4058750 A	15-11-77
US 4433898 A	28-02-84	NONE	
GB 1456394 A	24-11-76	US 4076376 A	28-02-78
AU 510340 B	19-06-80	NONE	
GB 2143651 A	13-02-85	US 4461537 A DE 3243309 A FR 2519150 A GB 2112170 A,B JP 58115410 A	24-07-84 07-07-83 01-07-83 13-07-83 09-07-83
EP 0053482 A	09-06-82	JP 1711508 C JP 57091568 A JP 62044828 B JP 1446792 C JP 57091569 A JP 62044829 B JP 1446793 C JP 57091570 A JP 62044830 B JP 1711510 C JP 57091573 A JP 62059478 B US 4539476 A	11-11-92 07-06-82 22-09-87 30-06-88 07-06-82 22-09-87 30-06-88 07-06-82 22-09-87 11-11-92 07-06-82 11-12-87 03-09-85