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**D E C I S I O N**  
**of 1 June 2006**

**Case Number:** T 0790/04 - 3.4.02

**Application Number:** 96300987.3

**Publication Number:** 0727825

**IPC:** H01L 31/16

**Language of the proceedings:** EN

**Title of invention:**

A photocoupler device and a producing process thereof

**Applicant:**

SHARP KABUSHIKI KAISHA

**Opponent:**

-

**Headword:**

-

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

"Inventive step (no) "

**Decisions cited:**

-

**Catchword:**

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Case Number: T 0790/04 - 3.4.02

**D E C I S I O N**  
of the Technical Board of Appeal 3.4.02  
of 1 June 2006

**Appellant:** SHARP KABUSHIKI KAISHA  
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Abeno-ku  
Osaka-shi  
Osaka-fu 545-0013 (JP)

**Representative:** Suckling, Andrew Michael  
Marks & Clerk  
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**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 2 February 2004  
refusing European application No. 96300987.3  
pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** A. Klein  
**Members:** A. Maaswinkel  
C. Rennie-Smith

## Summary of Facts and Submissions

I. The appellant lodged an appeal, received on 2 April 2004, against the decision of the examining division, dispatched on 2 February 2004, refusing the European patent application 96300987.3. The fee for the appeal was paid on 31 March 2004 and the statement setting out the grounds of appeal was received on 27 May 2004.

The examining division objected that the set of claims then on file was not allowable because the subject-matter of claims 1 to 7 did not involve an inventive step (Articles 52(1) and 56 EPC) having regard to the disclosures in the following documents:

- D1: Patent Abstracts of Japan vol. 017, no. 661  
(E-1471), 7 December 1993 and JP-A-05 218 493,  
including a computer-generated translation
- D2: Patent Abstracts of Japan vol. 012, no. 293  
(E-645), 10 August 1988 and JP-A-63 070 445.

In particular the division considered that the only difference between the subject-matter of claim 1 and the disclosure in D1 was that claim 1 defined a minimum value of 80% for the amount of filler in the light transmissive resin of the optocoupler, whereas document D1 was silent on the amount of filler in the resin. Since D1 did not specify the minimum filler concentration the skilled person had a clear incentive to perform standard trial-and-error experiments to find the minimum filler concentration by monitoring the failure rate of the optocoupler in relation to the filler concentration. Therefore the claimed 80% value for the filler concentration did not involve an inventive step over D1 alone. Furthermore D2 disclosed

that thermal stress was a general problem in the semiconductor packaging industry. In D2 this problem was solved in the same way as defined in claim 1, namely by adding up to 90% filler to the resin. Therefore the subject-matter of claim 1 was also suggested by a combination of D1 with D2.

- II. In the notice of appeal the appellant requested that the decision be rejected in its entirety and that a patent be granted on the basis of the set of claims on which the decision had been based. With the statement containing the grounds of appeal the appellant filed an auxiliary request for oral proceedings.
- III. In a communication pursuant to Article 11(1) RPBA and annexed to a summons to attend oral proceedings the board raised an objection under Article 84 EPC against claim 1 then on file. In this communication reference was also made to the further documents:
- D3: US-A-4 412 135
- D4: Patent Abstracts of Japan vol. 010, no. 213 (E-422), 14 March 1986 and JP-A-61 051 853
- D5: Patent Abstracts of Japan vol. 018, no. 425 (E-1590), 9 August 1994 and JP-A-06 132 427.
- IV. With a further letter dated and received 27 April 2006 the appellant filed a new set of claims. At the oral proceedings on 1 June 2006 the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the request dated 27 April 2006.

V. The documents comprising this request include:

Claims: 1 to 4, as received with the letter of  
27 April 2006;  
Description: pages 1 to 6 and 11 to 19 as originally  
filed;  
pages 7 and 10 as received with the  
letter of 12 February 2003;  
pages 8 and 9 as received with the  
letter of 27 April 2006;  
Drawings: sheets 1/10 to 10/10 as originally filed.

VI. The wording of independent claim 1 reads as follows:

"A photocoupler device comprising:  
a light-emitting chip (11);  
a light-receiving chip (12);  
a light-emitting side lead frame (13) for  
individually holding said light-emitting chip (11);  
a light-receiving side lead frame (14) for  
individually holding said light-receiving chip (11);  
a light-transmissive resin (15) as a first molding  
layer for covering said light-emitting and light-  
receiving chips (11, 12) opposed to each other so as to  
be optically coupled, said light-transmissive resin  
covering said chips (11, 12) and said lead frames (13,  
14) completely except for outside connecting terminal  
portions of said two lead frames, the light-  
transmissive resin (15) containing silicone in an  
amount of 1 to 20% by weight; and  
an opaque resin (16) as a second molding layer for  
covering said first molding layer;  
wherein said light-transmissive resin directly  
covers said light-emitting chip;

characterised in that said light-transmissive resin contains fillers in an amount of 80% by weight or more".

The wording of independent claim 4 reads as follows:

"A process of producing a photocoupler device, comprising the steps of:

arranging a light-emitting chip (11) and a light-receiving chip (12) in an opposing manner so as to be optically coupled, both said chips (11, 12) being mounted individually in respective lead frames (13, 14);

covering said above arrangement completely except in the outside connecting terminal portions of said two lead frames (13, 14) with a light-transmissive resin (15) as a first molding layer, said light-transmissive resin (15) containing silicone in an amount of 1 to 20% by weight; and

covering said first molding layer with an opaque resin (16) forming a second molding layer; characterised in that said light-transmissive resin (15) contains fillers in an amount of ranging from 80% to about 95% by weight".

Claims 2 and 3 are dependent claims.

VII. The appellant's arguments may be summarised as follows:

The subject-matter of the previous claim 3 has been incorporated into claim 1, in response to the board's objection under Article 84 EPC. With this amendment, claim 1 now corresponds in scope to the previous claim 7, to which no objection under Article 84 EPC has been raised.

A conventional photocoupler of the type shown in Figure 1 of the patent application suffers from two particular problems. The first problem, "problem 1", is related to the fact that the layers of transparent resin 6 and the layer of opaque resin 7 generally have different coefficients of expansion. This causes changes in surrounding temperature to lead to differential expansion or contraction, the generation of stresses in the device and, ultimately, the cracking of one of the resin layers. The second problem, "problem 2", is that there is also a difference in the coefficient of expansion of the light emitting chip 1 and that of the light-transmissive resin 6. This difference in thermal expansion coefficients again means that heating or cooling of the photo-coupler device causes stress, in particular in the light-emitting chip 1, ultimately leading to failure of the light-emitting chip.

Problem 1 has conventionally been addressed by adding filler to the light-transmissive resin 6 in order to alter its coefficient of expansion. In the prior art, for instance document D3, it is known to add up to 70% by weight of filler in order to reduce the difference between the coefficient of expansion of the light-transmissive resin and that of the opaque resin. Also document D1 discloses in paragraph [0008] to mix filler in the translucent resin but nowhere specifies a numerical value for the filler concentration.

It is acknowledged that document D1 also refers to problem 2 and offers two ways to solve this problem, but neither of these relates to selecting the filler

concentration of the light transmissive resin:  
paragraph [0013] of D1 proposes to carry out "silicone conversion" on the light-transmissive resin which, according to paragraph [0016], changes the cross-linking density and thereby reduces the contraction of the translucent resin at low temperatures. The second solution to problem 2 proposed in D1, at paragraph [0022], is to make the light-transmissive resin absorb moisture when it is hardening. This again has the effect of reducing the cross-linking density in the resin and reduces its glass transition temperature.

Thus, for solving problem 1 of D1, a skilled person selecting the amount of filler material for the translucent resin would naturally have followed the known teaching and selected a filler content of around 70% per weight, consistent with the teaching of D3, and would have had no reason to deviate from this known teaching. What is absent from the cited prior art is any suggestion that "problem 2" could be solved simply by choice of an appropriate filler concentration for the translucent resin. In particular, the only document addressing this second problem, document D1, offers two completely different solutions. The further documents D2, D4 and D5 do not relate to this problem at all.

Document D2 relates to the epoxy resin composition of a general "packaging design" for a semiconductor device and there is no disclosure that it would concern a photocoupler device. Indeed, there is no suggestion in D2 that the epoxy resin would be light-transmissive, therefore problem 2 is not relevant to D2 and is simply not addressed in this document. In document D4 problem 2 is not relevant either, since in the device



disclosed in D4 the light-transmissive resin 4 does not make direct contact with the chip 2. As to the filler content of the resin, the Abstract of D4 teaches a very wide range (20 parts to 800 parts filler to 100 parts resin, corresponding to approximately 17% to 89% by weight). Therefore even if a skilled person would have combined D4 and D1 there is no good reason why he would have contemplated applying the technical teaching of D4 in the range of overlap of the present patent application, since he would be aware that a filler concentration of 70% was effective to solve problem 1. Document D5 similarly does not address or even mention the problem of thermal stress generated between a light-emitting chip and a translucent resin in a photocoupler device. In fact it does not relate to a resin composition, but specifically relates to a filler composition for use as filler in a resin composition. Paragraph [0011] of D5 refers to a filler content of 60 to 85%. Thus the overlap with the filler content claimed in claim 1 is from 80% to 85%. However, the specific examples of resin compositions disclosed in D5 have filler contents below 80%, see tables 1 and 3 in which the resin compositions have filler contents of 79.8% and 69.8%, respectively. Indeed D5 confirms what the skilled person knew already, namely that in order to solve problem 1, filler contents of approximately 70% in the resin should be selected.

In conclusion, the skilled person, starting from the disclosure in D1 would not have had a reason to include in the transmissive resin a filler content of more than the known maximum value of 70% for solving problem 1. Since document D1 solves problem 2 in a different way and the further documents D2 to D5 do not address this

problem, he would have found no reason to combine the teachings of these documents. Therefore the subject-matter of claim 1, and similarly that of claim 4, involves an inventive step.

## **Reasons for the Decision**

1. The appeal is admissible.

2. *Amendments*

The added feature in claim 1 finds its basis in claim 3 as originally filed. Also the acknowledgement of the prior art is found to be admissible under Article 123(2) EPC.

3. *Patentability*

3.1 *Novelty*

3.1.1 As acknowledged in the description on page 8, first paragraph, document D1 discloses a photo-coupler device according to the preamble of claim 1.

3.1.2 According to the Abstract of D1, the light-transmissive resin contains filler and is silicone-modified. Neither the Abstract, nor the computer-generated translation of D1 discloses the amount of fillers in the light-transmissive resin. Therefore by reason of this feature the subject-matter of claim 1 is novel over the disclosure in D1. This applies similarly to the subject-matter of independent claim 4.

3.1.3 Neither do the further documents disclose subject-matter with all features of claim 1 or claim 4. The subject-matter of these claims is therefore novel.

3.2 *Inventive step*

3.2.1 Since the photocoupler device disclosed in document D1 has the most features in common with the subject-matter of claim 1 and since, furthermore, both problems 1 and 2 as referred to in paragraph VII above are addressed in this document, the disclosure in D1 may be regarded as the closest prior art.

3.2.2 With respect to the objective technical problem, the appellant has argued that the feature defined in the characterising portion of claim 1, the selection of fillers in the light-transmissive resin in an amount 80% by weight or more, solves problem 2 and that, whereas D1 does not disclose any particular percentage of the amount of fillers, in the device of D1 these are exclusively included in the transmissive resin for solving problem 1. According to the appellant, for problem 2 document D1 offers two solutions which are basically different from the solution proposed in the patent application.

3.2.3 It appears, however, that the silicone-modification disclosed in document D1 as one of the solutions for problem 2 is also part of the solution defined in the present patent application (see page 8, lines 19 to 22; and page 9, lines 6 to 11 of the original description). Furthermore, problems 1 and 2 both relate to the differential thermal expansion of the transmissive resin (problem 1: with respect to the opaque resin;

problem 2: with respect to the light-emitting chip) and the solution (both in D1 and in the patent application) for both problems relates to selecting the composition and properties of the transmissive resin (adding of filler; and silicone modification).

3.2.4 Therefore, since document D1 addresses both problems 1 and 2 and discloses elements of the same generic solution as defined in claim 1 - silicone-modification of the resin and inclusion of filler material - the objective technical problem to be defined by the feature in the characterising portion of claim 1 should be seen in the particular selection of an appropriate amount of filler material in the resin.

3.2.5 In this context the appellant has argued with reference to document D3 that it was known from the prior art that this percentage of 70% was effective for solving the problem of reducing the thermal stress between the transmissive resin and the opaque resin and that the skilled person would have had no motivation to depart from the known teaching. This reasoning appears to suggest that there would have been a technical prejudice against selecting higher percentages of fillers.

3.2.6 In the opinion of the board, however, the documents on file do not give any evidence for such a prejudice: in document D2 (Abstract; also two values in Table 2), document D4 (Abstract) as well as in D5 ([paragraph 0011]) percentages of fillers in transparent resins above 70% are disclosed and neither in these documents, nor in document D3 cited by the appellant, is there any indication that increasing the percentage of filler

above this percentage would be detrimental to the properties of the resin.

3.2.7 Furthermore the present patent application does not provide conclusive proof that the selection of an amount of filler above 70%, in particular above 80%, in a silicone-modified transmissive resin would provide any advantages. It is true that Figure 7 shows that increasing the filler content results in a lower CTR degrading portion, but this Figure shows the behaviour of a device comprising a transparent epoxy resin without silicone modification (see page 13, lines 1 to 13 of the original description). As is immediately clear from Figure 8, the inclusion of silicone in the epoxy resin with a filler content of 86.5% in a percentage of 1% or more results in a CTR degrading proportion of effectively 0% (page 13, line 15 to page 14, line 8). Since the most left data point in Figure 8 (filler content 86.5% and 0% silicone content) corresponds to the most right data point in Figure 7, it is expected that for a silicone-modified resin the other data points (e.g., for a filler content of 70%) would similarly result in a lower CTR degrading portion. Hence, since the patent application does not give such data which would have been more meaningful for assessing a contribution to inventive step, the data shown in Figures 7 and 8 cannot be taken as such evidence. It is added that, when asked at the oral proceedings, the representative regretted that no further data in this respect was available.

3.2.8 Therefore, in the opinion of the board, the skilled person, when starting from the disclosure in document D1 for obtaining a photocoupler device and addressing

the objective problem to select the amount of filler material of the light-transmissive resin would consider the full range of possible percentages, because filler percentages above 70% by weight are known in the art, and since the available prior art does not provide any reason why the maximum percentage of fillers should be restricted to a particular value. Since the selection of the amount of fillers would only include rather basic trial-and error tests and not involve undue experimental work he would carry out such tests using only normal ability. Furthermore, since the applicants could not show that the selection defined in claim 1 results in a particular unexpected technical effect this subject-matter does not involve an inventive step.

3.2.9 A similar objection arises against independent claim 4. The set of claims is therefore not allowable.

## **Order**

**For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:

M. Kiehl

A. Klein