SDIP-Packaged High-Speed Coupler Series

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Abstract

Backed by the rise in environmental concern and demands for energy saving, the fields involving inverter controls such as FA (Factory Automation) and home appliances incorporating photocouplers are required both to reduce their system sizes and improve their functions. This paper introduces a series of SDIP (Shrink Dual Inline Package) -packaged photocouplers that features a reduction of the mounting area by about a half while maintaining the package structure parameters in compliance with the safety standards of high-speed couplers and IGBT gate-drive couplers.

Keywords

photocoupler, inverter, small package, SDIP, FA (Factory Automation), safety standard

1. Introduction

Backed by the rise in environmental concern and demands for energy saving, the fields involving inverter controls such as industrial equipment (FA) and home appliances have recently been improving the efficiency, function and performance of their systems.

In particular, photocouplers are now used widely based on environmental considerations for general-purpose inverters in the FA market and for air conditioners and other white goods in the consumer market as well as for solar panels and wind power generation. Their applications are expected to achieve significant growth with an estimated annual growth rate of 8% until 2010. In the FA market subject to the requirements for functional improvements at the same time as for system size reduction, the calls for enhancing the integration of semiconductor devices and implementing them in smaller packages are becoming more demanding than ever. As systems are sometimes used in high-voltage environments of 200 to 600V, the photocouplers used in electrical insulation are also required to comply with global safety standards and to have their insulation characteristics enhanced. This paper will introduce the size reduction technology and the actual compact photocoupler products that are packaged in 6-pin SDIP (Shrink Dual Inline Package) [*1] . This technology has been developed in order to meet the above user needs by halving the mounting area while at the same time maintaining the package structure parameters that are compliant to the relevant safety standards.

2. Photocoupler Structure

The photocoupler is an electronic component fabricated by packaging a light emitting diode and a Photo-Diode for converting light into an electrical signal. It is packaged in a molded unit in order to insulate the electricity inside. Since the photocoupler is an insulation component, it is subjected to structural restrictions that are usually not applied to other semiconductor packages because it has to satisfy the safety standards of many countries. There are three main parameters involved in its architecture as shown below (**Fig. 1**).

1) Air Distance

A minimum path through air distance between the external lead on the input side and that on the output side.

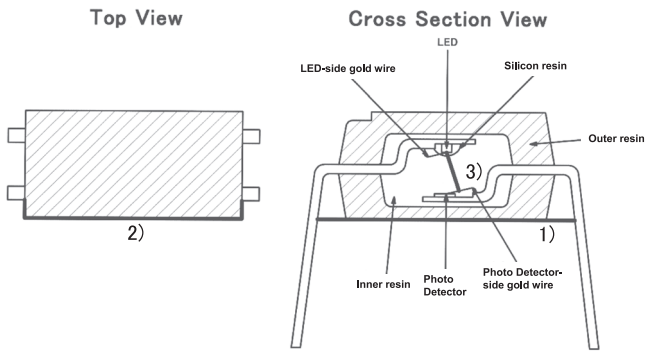

Fig. 1 General photocoupler structure.

[*1] In the photocoupler market, any packages that are smaller than the traditional 8-pin DIP are referred to by the generic term of SDIP.

2) Creepage Distance

A minimum distance along the mold resin between the lead on the input side and that on the output side.

3) Insulation Thickness

A minimum distance between the conductor on the input side and that on the output side.

As systems in the FA market are sometimes used in high-voltage environments of 200 to 600V, the photocoupler package must comply with global safety standards and may be used in a wide range of applications if an air distance of ≧8.0mm, a creepage distance of ≧8.0mm and an insulation thickness of ≧0.4mm can be guaranteed.

In the past, the 8-pin DIP (Dual Inline Package) satisfying the package structure parameter requirements has been used generally in these applications. However, since it is considered that a size reduction in the photocoupler packages that are used in large quantities is indispensable for the size reduction of systems, it has become a very important issue to reduce the size of the photocoupler package while at the same time retaining the requisite package structure parameters.

3. SDIP Package Assembly Technology

The design issues for reducing the size of the photocoupler package are to satisfy the heat resistance and the withstanding voltage characteristics while securing the package structure parameters as described above. In order to resolve these issues, we have adopted the following techniques and implemented the 6-pin SDIP package.

(1) Securing the Structural Parameters

To reduce the package size from the traditional 8-pin DIP to SDIP, we have optimized the angle (tapering) of the mold side of the package and have achieved a creepage distance of 8mm. At the same time, we have also modified the lead shape and halved the pin pitch to 1.27mm to enable size reduction.

(2) Securing the Withstanding Voltage

We adopted the W-shaped structure (**Fig. 2**) as the package structure to achieve high-speed switching with improved light transmission efficiency and secured an insulation thickness of 0.4mm. We also optimized the thickness and area of the insulation film and inserted it between the LED and light-receiving elements (the Photo Detector) in the package in order to secure the withstanding voltage at the same level as the previous package and comply with the relevant global safety standards.

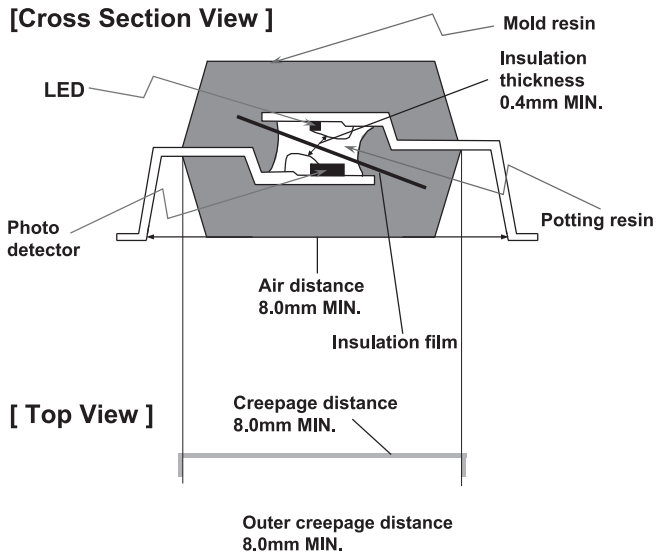

Fig. 2 SDIP W-shaped package structure.

(3) Securing the Package's Heat Resistance

If the mount position of the insulation film is deviated, the package tends to be cracked due to the difference in the thermal expansion coefficient between the mold resin and the insulation film, and the heat resistance of the package would thus be affected. To prevent this happening, we reduced the insulation film mounting position deviation and optimized the amount and the dropping method of the potting resin of the photo detector in order to enable mounting it stably and with high accuracy.

4. Lineup of SDIP Packaged Products

Photo shows the external view of the commercialized SDIP and **Table** displays its details. The most impressive feature of the new 6-pin SDIP is that its mounting area can be reduced by about a half compared to that of the traditional 8-pin DIP.

The LED is a GaAlAs type high-speed LED, and five kinds of photo detector are available according to application as shown in Table.

The new products are also compliant to the global safety standards. Particularly, the two models PS8302 and PS9313 guarantee a maximum operable ambient temperature of 110°C

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Table SDIP package lineup.

		Product	Main Characteristics				
			Creepage (mm)	BV (Vrms)	t_{PHL} / t_{PLH} (ns)	C_{MH} / C_{ML} (kV/μs)	Other
1Mbps	Analog	PS8302L2	8	5000	800 / 800 (MAX.)	15 / -15 (MIN.)	CTR=15%(MIN.)
	Digital	PS9303L2			600 / 600 (MAX.)	15 /-15 (MIN.)	IFLH=5mA(MAX.) PWD=550ns(MAX.) Active High output
	Digital	PS9313L2			500 / 750 (MAX.)	15 /-15 (MIN.)	IFHL=5mA(MAX.) PWD=650ns(MAX.)
10Mbps	Digital	PS9317L2			75 / 75 (MAX.)	15 /-15 (MIN.)	IFHL=5mA(MAX.) PWD=35ns(MAX.)
IGBT gate drive	—	PS9301L2			650 / 650 (MAX.)	15 /-15 (MIN.)	IFLH=5mA(MAX.) PWD=500ns(MAX.)

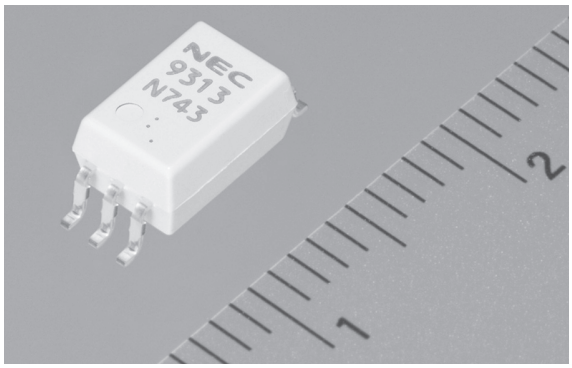

Photo SDIP package (PS9313).

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in a high-speed communication application of 1Mbps and the PS9317 features operation at an even higher speed of 10Mbps.

5. Future Perspectives, Conclusion

We consider that the new products described above, which are currently deploying positive sales activities, are capable of reducing the sizes of various systems including FA. In the future, we will offer products meeting more diverse user needs in a timely manner and enhance product appeal by developing new packages and by reducing power consumption even further in order to promote the development of products that feature effective environmental measures.

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