Guiding the Light Perfectly

OPTICAL WAVEGUIDE WITH MULTIPLE DISPLAY

LED illumination is not only more efficient than conventional light bulbs but also have a much longer lifetime. In many devices the small colored dots are essential. In order to implement them, suitable optical waveguides are needed in most LED applications.

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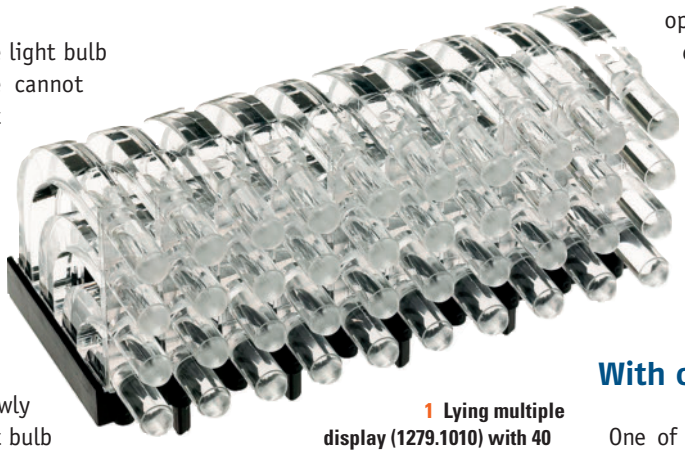
Since the invention of the light bulb in the 19th century, we cannot imagine living without artificial light. LED technology is younger but just as revolutionary. The commercial distribution of LEDs started in the early 1960s; at that time, nobody had the slightest idea about today's technological possibilities.

In the meantime, LEDs slowly but surely are leaving the light bulb behind. Better ecological and economical values are the reason for it. LED technology has become an essential part in the most diverse equipment of industry and everyday life. Think of the status indicators in coffee makers or display elements of cooktops and electric kettles. The same applies to automotive engineering, where LEDs are used to illuminate the interior, e.g. in handle trays, consoles, compartments and the driver's front panel. Even classical fields of application in control electronics would nowadays be unthinkable without this technology. But without the use of optical waveguides (OWGs) most LED applications cannot be realized. Only OWGs enable the desired emittance characteristics at any freely determinable optical outlet face. The function of the OWG is based on the principle of total internal reflection. Total reflection means that the light beam is reflected completely by the medium and transferred free of losses.



1 Lying multiple display (1279.1010) with 40 spherical optical outlet faces of 3 mm diameter each; optical outlet face horizontal to PCB; with glare protection

For decades Mentor has been developing and manufacturing mechanical sensor technology based, electronic and optoelectronic components which also comprise a wide range of light guides and components. These OWG are designed for almost every field of use and available in several varieties for diverse applications.

With or without diaphragm

One of Mentor's latest developments is the multiple-display (Figure 1) from the ›1279.x‹ line. It is employed in control electronics, medical engineering and telecommunications technology as well as in readout systems in mechanical engineering and construction. The horizontally emitting light guide system is made of transparent UL94-listed plastic and has a spherical emitting face with a diameter of 3 mm. It can be used with SMD LEDs since it is designed in a raster size of 5.08 mm. These LEDs can be inserted fully automatically which reduces mounting costs compared to the mounting of the THT variant.

The drive-in pins of the light guide are used to stabilize the OWG on the printed circuit board (PCB). With the lying variant of the multiple displays the light of the LED is lead parallel to the PCB to the front panel and here emitted through the optical outlet faces. A OWG length of up to 15 mm is available, according to the respective installation instructions. With a defined ambient temperature of –40 to +85 °C the displays have an ESD protection of up to 12 kV against the front panel – thus protecting the sensitive electronics against electro static discharge.

Variants with 4x to 40x displays are available depending on the field of application. Especially for the simultaneous use of mixed colors, the integrated black diaphragm (**Title picture**), which prevents glare from one light guide to an adjacent one, renders outstanding service. In this way external irradiation impairing the optical outlet face and possibly creating undesired mixed colors can be avoided. In addition, inactive light guides are protected against glare. Otherwise, they might emit light and display a wrong signal state. By means of the diaphragm the LED light will be flawlessly guided to the respective optical outlet face.

The upright design of the light guide is part of the ›1272.x‹ line (**Figure 2**). They are used when the PCB has to be arranged horizontally to the optical outlets, since with this display system light is guided vertically from the PCB to the front panel. The optical outlet face has the same diameter as the lying type (3 mm). A glare protection, which meets the already described demands to avoid glare, is optionally available in order to enable multicolor display systems. It is deliverable as a 2x up to a 10x display with the variable length of the OWG from 9 to 45 mm. This analog display method can be found, for example, in bar indicator as well as in control or mixing desks.

Mini displays

The new miniature systems (**Figure 3**) – lying or horizontally emitting as well as upright or vertically emitting – are designed for chip LEDs of the type ›0805‹ and have a size of 0.2 x 1.25 x 0.8 mm³ or smaller for most cramped space conditions on the PCB. The miniature component displays signal modes on instrument panels, systems and electronic circuits as well as on control units of diagnostic devices.

The spherical optical outlet face of the minis has a diameter of 2 mm. The miniature upright and horizontal multiple displays are mountable side by side in a raster size of 5.08 mm, just as their bigger counterparts. Both are protected by black diaphragms against glare of the single light guides. The drive-in pins at the diaphragm allow a stable fixation on the PCB. Moreover, both types show an ESD protection of up to 8 kV against the front panel with an ambient temperature ranging from –40 to +85 °C.

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With the horizontal miniature ›1296.1x‹ of the 4x light guide with 90° arched light guides all lengths between 2.8 and 12.8 mm can be realized for the light guide and the component can alternatively be also delivered as 1x, 2x and 3x display in the corresponding raster size.

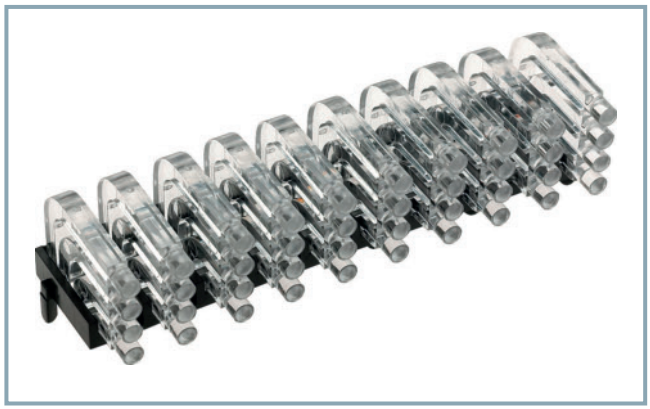
2 Upright multiple display (1272.1020) with ten spherical optical outlet faces of 3 mm diameter each; without glare protection on the left and with glare protection on the right

The standard version of the upright multiple miniature displays 1296.2x and 1296.3x are available as 4x and 20x displays (**Figure 4**). Upon request, all other variants in between can be offered. Their length may be determined freely between 5 and 45 mm.

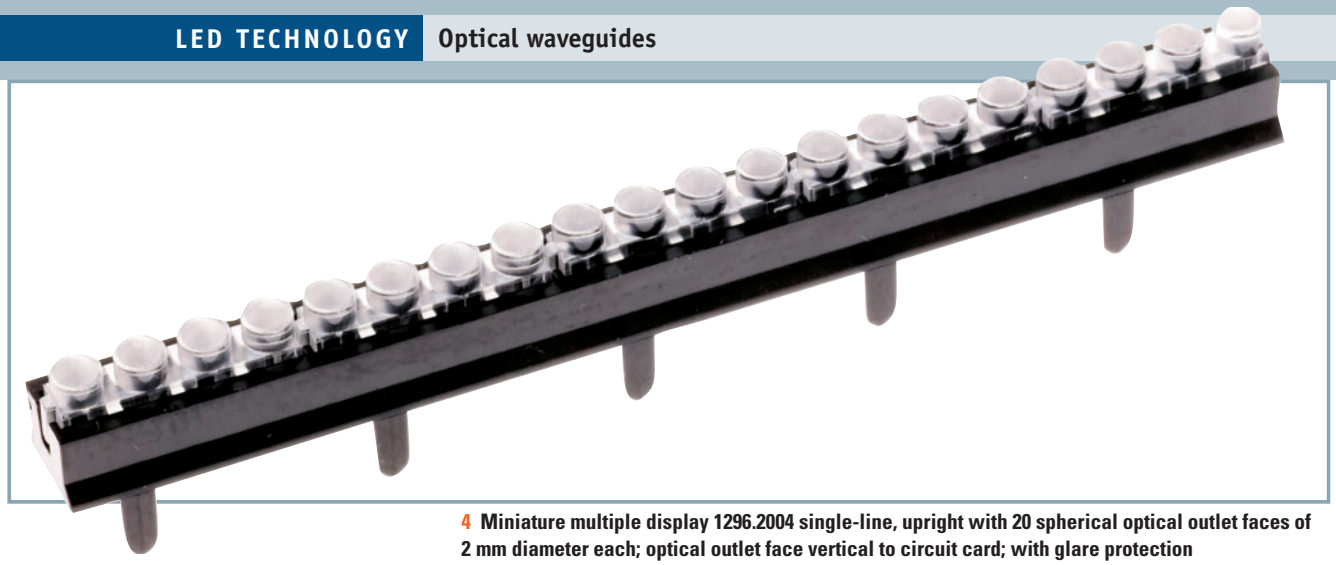
Withstands harsh conditions

Aside from the many multiple-purpose displays available and already introduced the opto-electronic specialist Mentor offers a wide range of optical light guides tailored to specific needs: for instance OWG systems made of flexible materials or colored OWGs that can be used for orientation during off-line operation of the LED.

Also high-temperature resistant light guide which can be manufactured according to customer demands and fields of application are possible. The standard version of the wave guides with inte- ▶



3 Lying type of miniature multiple display (1296.1104) with 40 spherical optical outlet faces of 2 mm diameter each; optical outlet face horizontal to PCB; with glare protection



4 Miniature multiple display 1296.2004 single-line, upright with 20 spherical optical outlet faces of 2 mm diameter each; optical outlet face vertical to circuit card; with glare protection

grated SMD LEDs, which are mounted in one step on a PCB, are high-temperature resistant. New in the program are OWG with the protection class IP68. They are waterproofed against the front panel. By means of a special sealing geometry at the light guide in combination with a determined dowel hole at the front panel they can be mounted waterproof without additional adhesive bonding. This shows that the possible uses of LEDs and light guides in specific application requirements are nearly unlimited. ■

Summary: For all purposes

The LED is chasing the light bulb. But only the OWG enables the desired emittance characteristics of the LED at any optical outlet face desired. The OWG with four to forty displays is available as vertical and horizontal version, with or without glare protection. It works at temperatures between –40 and +85 °C. The miniatures with four to twenty displays are meant for the use of extremely small chip-LEDs. They are equipped in exactly the same way the large display types are. Flexible material, colored OWGs or types with the protection class IP68 are available for special cases, too.

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