HD Matrix LED headlights

Presskit

Inhalt

Performance leap in light technology

The high-resolution Porsche LED main headlights with HD matrix beam

Porsche has developed the light technology of the next generation with its new high-resolution HD matrix technology. The core element of the innovation created in collaboration with partners is a chip that combines over 16,000 individually controllable micro-LEDs onto the surface area the size of a thumbnail. Of these LED chips, two are utilised for each headlight – four per vehicle. The headlights with HD matrix technology therefore offer a high-resolution light distribution up to twice as bright on a surface four times larger than previous top-notch systems. The driver benefits from the highly flexible light that the new development makes possible thanks to extremely homogeneous illumination. In addition, there are innovative functions such as lane illumination, construction and narrow-lane light and adaptive motorway high-beam lights. The high-performance high beam turns night into day at a distance of up to 600 metres. A new non-dazzling high beam function is used for oncoming vehicles: large areas to the right and left of the anti-dazzling gap become significantly brighter. The new HD matrix technology adds yet another highly efficient component. Because the HD matrix headlights only activate the pixels that are actually needed at any given moment, they consume considerably less energy that other high-resolution systems, while the amount of light remains the same.

In addition to four-point daytime driving lights and static cornering lights, the new Porsche headlight includes two of the new HD matrix modules and two bi-functional modules for courtesy lighting and the auxiliary high beam. These four main light sources are arranged in a four-point design characteristic of the brand. The previous top headlight from Porsche, by contrast, features four courtesy modules and a central Matrix module in 84-pixel technology. The new HD matrix technology also stands apart in terms of design: for the first time, the characteristic Porsche four-point headlight graphics of the daytime running lights can also be seen at night when the new system is used – with both low and high beams. The HD matrix headlights will be introduced successively in different model lines with identical module technology but adapted designs. In the development process, Porsche submitted over 25 patents for the innovative technology.

World's first high-resolution LED matrix light

The new technology must unite different, and sometimes contradictory, requirements in a single system. The aim is to distribute all light functions among four units per headlight for design reasons. Nonetheless, the individual sources of light should still combine in a way that provides homogeneous and powerful illumination at the same time. Pre-design simulations were used to analyse which overall system design would best meet all requirements – including those of customers. As a result, Porsche opted for the new and efficient HD matrix LED technology with 16,384 pixels per module rather than the maximum resolution that is technically feasible.

The design of the headlight is clearly structured. Four almost squarely arranged light modules, each complemented by a narrow daytime running light strip above the module, trace the brand's characteristic four-point design – by day and by night. The two upper bi-functional modules are identical and provide the courtesy lighting and auxiliary high beam with three LEDs each.

The heart of the new HD matrix technology is the two lower light units. Each features an identical LED array with integrated LED driver (ASIC) that generates an unprecedented high-resolution luminous flux in an area of just 12.8 millimetres by 3.2 millimetres. The system controller – comparable to a powerful graphics card – not only activates but also controls the brightness of each of the 16,384 individual light-emitting diodes per LED array in 1,024 steps. Different lenses, each with specifically ground optical glass, complete the two HD modules.

The lenses produce different illumination angles. The wide-angle lens of the outer HD matrix module's 'illumination' covers an angle of 40 degrees of width by ten degree of height. The inner 'Performance' HD matrix module with telephoto lens radiates the light at 20 degrees by five degrees. Its illumination is therefore only half as high and half as wide, but significantly brighter. The light distributed by the two HD modules overlap in the centre. The new headlight thereby combines wide illumination with high intensity in the central area.

The performance leap in light technology can be attributed to this efficient generation of light and the combination of the two HD matrix modules with the two bi-functional modules. With a total of 32,768 individually controllable pixels per headlight, the HD matrix modules generate direct high-resolution light. Only the light that is actually required is generated. This is why it is known as active matrix light generation.

The HD matrix light illuminates the entire 40-degree horizontal and ten-degree vertical range with a luminous flux of over 1,400 lumens, thereby generating one of the largest and brightest high-resolution illumination areas. It covers the entire high beam range and begins just in front of the vehicle. The light can be distributed in any way within this area and this flexibility makes it possible to improve existing functions and introduce new ones – always with the aim of offering the driver the best possible visibility in any situation.

Optimised and new functions for greater safety and comfort

– High beam with auxiliary high beam (high-performance high beam): If the system does not detect any vehicles driving ahead or oncoming vehicles, and the automatic high beam is active, the HD matrix modules switch from dipped beam to high beam, and the auxiliary high beam of the upper bi-functional modules is automatically switched on. This ensures an increase in the beam length and increases the performance of the high beam. More than 600 metres if the road is illuminated.

– Non-dazzling high beam with new function: If the camera detects a vehicle ahead or an oncoming vehicle, the auxiliary high beam is deactivated and the vehicle is selectively masked out by switching off the corresponding pixels of the HD matrix modules. The energy that this frees up is converted into additional, functional HD light. The full width of the available HD light is used to optimise the illumination of the non-dazzling high beam and to improve the driver's visibility – without dazzling other drivers. When anti-dazzling is activated, the amount of light from the HD matrix module to the right and left of the anti-dazzling gap is doubled, resulting in significant brightening of the remaining high beam range.

– Lane illumination: This function is used for better illumination of the vehicle's own lane in the form of a light carpet. The lane between the road markings becomes significantly brighter. And this regardless of the vehicle's position in the lane. Whether the vehicle is further to the right, further to the left or in the middle – the light carpet adheres to the road markings as if it were a magnet. The function is activated exclusively on motorways or comparable roads. It enables early detection of hazardous objects and reduces lane changes by other, less attentive drivers into the vehicle's own lane. In the case of deliberate lane changes, the light carpet is briefly widened to cover both lanes when the marking is crossed, before subsequently illuminating only the new lane more brightly once the lane change is complete.

– Construction and narrow-lane light: When construction zones or narrow areas are detected, the light carpet is automatically reduced to the same width as the vehicle, including mirrors, to brighten the lane and thus make it visible to the driver. This visual support enables drivers to better assess their position in the narrow lane as well as overtaking manoeuvres. Steering and speed corrections are demonstrably reduced, with lane keeping and road safety being enhanced as a result.

– Adaptive motorway high beam: On motorways and comparable high-speed roads, the control system ensures the best possible illumination of the driver's lane while also optimally adapting the light distribution to the conditions on the motorway. The illumination is cut off with a soft transition towards the median strip, which prevents drivers in the oncoming lane being dazzled.

– Animation as greeting and send-off: When locking and unlocking the vehicle, the dipped beam of the four-point headlights ensures visibility and safety in front of and around the vehicle. The vehicle sends the driver off with a discreet animation: the HD matrix modules generate two headlight graphics in a four-point design that is characteristic of the brand and which sweep horizontally over any walls opposite or garage doors, for example, before going out. The light system then activates the animation in reverse order when the parked vehicle is unlocked and the driver's door is opened.

.

The new Porsche light tunnel

Development tool for the headlight technology of tomorrow: New light tunnel

Light technology is developing rapidly. To make the most of its potential, Porsche has designed a new light tunnel. After taking roughly three years to complete, this state-of-the-art development instrument will start operation at the turn of the year. The light tunnel is directly adjacent to the design studio at the Weissach Development Centre. The one-and-a-half storey building offers some 2,300 square metres of floor space. The mezzanine level has a test facility for automatic test procedures for legally prescribed light measurements, as well as a warehouse for sample headlights from many Porsche vehicle models. The front area of the new building is used to prepare the trials. This is where the vehicles are cleared of snow and ice, if applicable, in an airlock. If necessary, the headlights can also be swapped here. The building also has an in-house analysis and testing laboratory for independent measurements of the luminous intensity and light distribution of headlights.

The heart of the system is a 100-metre-long and 15-metre-wide test track. For the first time, this enables developers and designers to test and fine-tune light systems under consistent conditions at any time of day or night, regardless of weather conditions. The tests can range, for example, from the simple presentation of a headlight using a sample to a situation involving oncoming traffic in road traffic. The 100-metre-long asphalt track features a two-lane design for this purpose. For a given situation, the dazzle from oncoming traffic can be identified at an early stage in the light development process. In a further scenario, the two vehicles are placed next to each other at the start of the test track – this allows a direct comparison of the beam length, illuminated area and headlight graphics.

Two mobile folding partitions make it possible to divide the test track into up to three individual sections to circumscribe the spaces for light testing. This enables experts to assess different lighting situations in isolation – for example, headlights and tail lights. A mobile ten-metre screen that enables the display and evaluation of light distributions is installed in the first segment. The vehicle stands on a very precisely levelled surface to enable examination of factors that impact the vehicle level, such as the air suspension or load.

Extremely smooth walls and ceiling for undistorted light distribution

The floor, walls and ceilings of the new light tunnel have been specifically adapted for the intended use. The wall and ceiling areas are dark grey and feature a homogeneous colour over the entire track distance. This is a fundamental requirement for defining and checking the exact light distribution of high-resolution headlamps. “Unevenness, reflections or deviations in colour inevitably falsify the result,” says Steffen Poganatz, the Overall Project Manager for the construction project. The walls are therefore also exceptionally smoothly plastered and coated with a matte paint, since even a slight unevenness of just a few millimetres would be visible in the light. The four-meter-high ceiling also has a low-reflection design.

This optimal environment also helps identify variations in the luminous intensity of individual LEDs in a matrix headlight. Manufacturing tolerances like these can be largely compensated by means of an adapted control setup. “When cornering in particular, such deviations may become noticeable in the form of abnormalities in carpet of light,” explains Markus Heinrich, Specialist for Front Lighting Systems.

The light tunnel significantly improves and shortens development capabilities and times for complex light systems. Until now, developers had to wait for darkness to fall in order to examine or compare light systems. In the summer months in particular, this usually meant working at night. And the results were only partially comparable: “Wet conditions, the composition of the asphalt and the ambient lighting also significantly influence the impression,” says Jörg Biegling, Manager of Light System Testing and Integration.

Light Design

Typical Porsche four-point light graphics at night

With the development of its new HD matrix headlights, Porsche is sending a strong signal of its focus on performance and brand design: “It is now possible for the first time to bring the four-point lighting graphics of the daytime running lights to the night as well,” says Porsche Designer Heinz Redlich. The innovative lighting technology is ushering in a new chapter in the Porsche light strategy.

The HD matrix technology offers designers new possibilities for the development of future headlight generations. Light design, after all, has traditionally played a fundamental role in the Porsche brand identity. Earlier sports car generations were identifiable as Porsche models at night by the positioning of the headlights and position lights. “We have continually refined this light signature both graphically and technologically,” explains the designer. These classic graphics reached their zenith with the use of dual LED light guides for the position lights in the Turbo models.

A new era of Porsche light design began with the 918 Spyder in 2013. The four-point daytime running lights were integrated in all-LED headlights for the first time. This unmistakable distinguishing feature of the super sports car would become the model for all Porsche vehicles developed thereafter. “With the HD matrix headlight, we have now taken two major development steps at once: both technologically and in terms of the design,” says a satisfied Heinz Redlich.

The new light tunnel is an indispensable tool for the further development of the new technology. “It offers us the critical ability to observe our lights from a distance irrespective of the daylight and weather conditions,” says Heinz Redlich. The only problem: the LED light sources are very small; the gaps and brightness are slightly deceiving when viewed at short distances. “The light signature in the rear in particular appears totally different at a greater distance than up close,” explains the designer. “The 100-metre stretch of the light tunnel allows us to assess the night design under real conditions at an early stage.”

Thanks to the HD matrix technology, future Porsche models will now be clearly identifiable by their light signatures at night as well.