

**MAGNETI  
MARELLI**

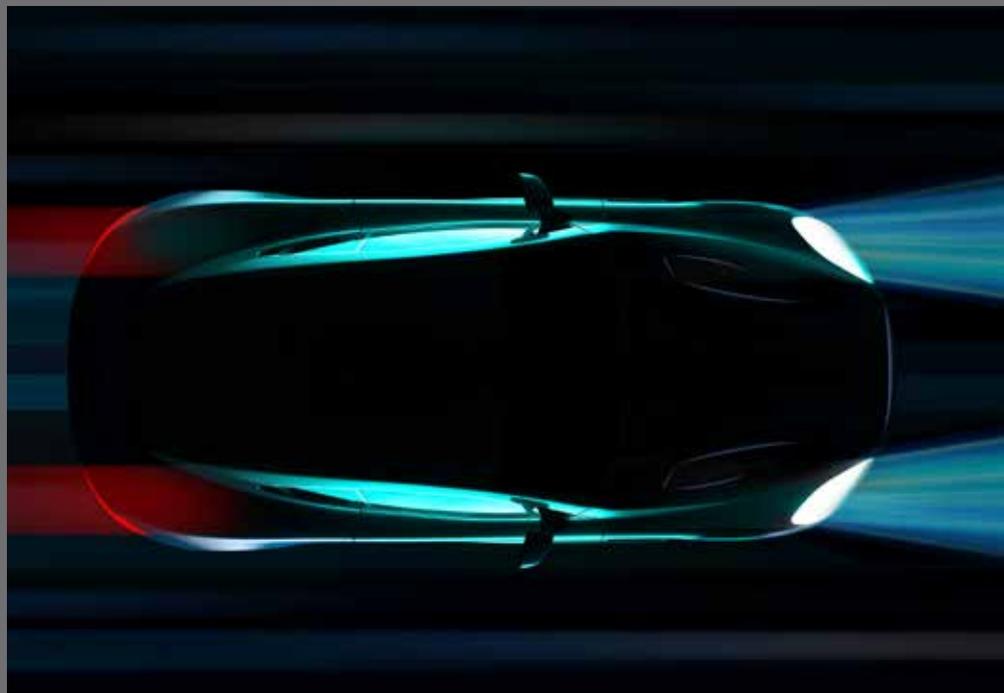


2019 PROPERTIES

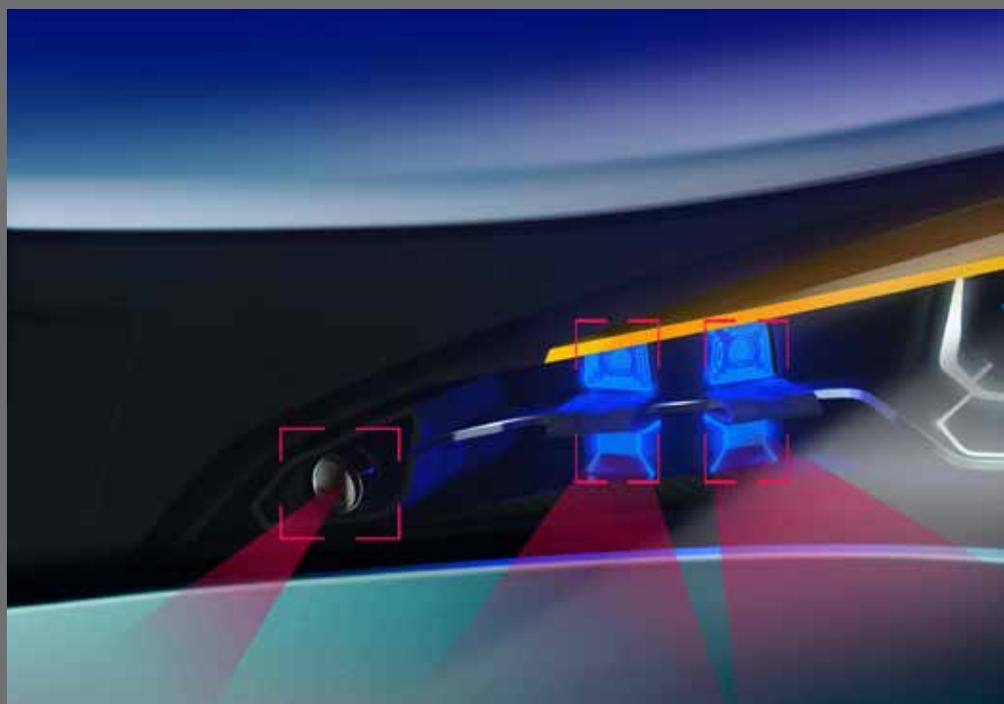
ELECTRONICS



LIGHTING



AUTONOMOUS &  
CONNECTED VEHICLE





Magneti Marelli provides smart, streamlined, and highly integrated lighting and electronics solutions focused on autonomous driving and connectivity. Our technology improves communication between the vehicle, its occupants, and the surrounding environment, increasing safety. These solutions literally enable vehicles to “sense” and connect with what’s around them, display critical feedback to the driver and passengers, and meet stringent environmental and safety requirements. By responding to these emerging trends we enable global automakers to Sense What’s Coming. We believe the autonomous and connected future is closer than many may think.

Drawing on 100 years of innovation in motorsport and passenger vehicle technology, we help OEMs bridge the gap as the industry evolves by providing solutions for the vehicles of today and the car of tomorrow.

**Sense What’s Coming, We’re Closer Than You Think**

# ELECTRONICS



## THE E-COCKPIT EVOLUTION

New trends in automation, connectivity, and mobility are driving the evolution of the vehicle interior. Digitalization, large displays, and innovations in HMI technologies and design are contributing to the integration of multiple displays to create full e-Cockpits that can include:

- Integration behind a single decorative piece (monolithic aspect ratio), using a black panel to hide displays
- Displays that can accommodate a flat and/or curved surface with enhanced optical bonding
- Complex structures to enable a plastic or glass decorative panel
- An integrated touchscreen and sensors for display proximity, gesture control, or smart buttons
- Biometric controls to identify users and release new functionality
- Enhanced displays with glasses-free 3D vision or improved legibility
- Distributed and personalized HMI

Magneti Marelli is focused on providing solutions that support the display of information and controls on any surface (free-form, curved, AMOLED). The company is also developing the backstage elements of the e-Cockpit with up-to-date solutions including:

Electronic Control Unit (ECU/SoC) for Infotainment | Instrument Cluster | Cockpit ECU  
HMI ECU | Telematics Box | Smart Antenna | Connectivity Gateway

## PRIVACY

The evolution of the cockpit is putting more emphasis on providing content dedicated to passengers, however this introduces safety concerns for the driver. Passenger content can be viewed by the driver while the car is parked or in autonomous mode, otherwise it needs to be restricted to the passenger to reduce driver distraction. Suppliers and OEMs are focused on providing enriched content currently prohibited (such as a full-length movie) in prep for autonomous driving, as well as ways in which to reduce light stress on the driver at night. In a Level 5 autonomous vehicle or Robo-Taxi scenario, occupants will have, on-demand, the ability to block their screen content from view by others in the vehicle. Magneti Marelli is working on proposed displays with switchable viewing angles to meet these requirements.

## GLASSES-FREE 3D

While automotive displays are becoming increasingly sophisticated, they are missing the portrayal of the third dimension. 3D displays can be useful for perception of the surrounding environment, during a parking sequence, or to provide immersive navigation. 3D displays can replicate complex surfaces of an object or they can be used to display alerts to the driver. Magneti Marelli is developing glasses-free 3D screens that provide advantages over traditional 3D technologies, avoiding cumbersome eyewear while offering better depth than multi-layer

screens at a lower cost. The company is working on technology to support 3D clusters with realistic scenes, central displays with 3D infotainment content, heads up displays (HUD) with variable depth information for augmented reality, and 3D rearview perception.

## ADVANCED RESPONSIVE AND DISTRIBUTED HMI

Combined with the e-Cockpit, Magneti Marelli is proposing innovative advanced HMI solutions and tools to enhance the driver and passenger experience. Multiple displays can support toggling content between different areas of the cockpit.

Advanced Responsive design allows for:

- Singular HMI logic to be used in various cockpit display configurations
- The predisposed HMI to be set to full/light or content/control in allocated displays or a screen area

Content distribution allows for:

- Content allocation based on user request (pushing HMI to a specific display)
- Dynamic allocation of content based on the context
- Variation of the interaction in function based on the user or allocated display

## HOLISTIC HMI DRIVES TAILOR-MADE USER EXPERIENCES

Our Display Showcases personify our vision of the evolving vehicle interior, from digital instrumentation and full e-Cockpit concepts, to technology that transforms the interior into a living cabin.

### **Portal Multi-Reconfigurable 37" Display Showcase**

Our Portal Showcase is a shared view display providing content for everyone in the vehicle. With its large size and multiple (37" bar type) reconfigurable displays, it puts information in the right location at the right time. It incorporates active-matrix organic light-emitting diode (AMOLED), a display technology primarily used in wearables. AMOLED displays consist of millions of LEDs and emit light directly, therefore providing better contrast, more vibrant colors, real blacks, and a wider viewing angle than traditional displays.

The Portal Showcase incorporates flat, 1.5mm thick displays bonded to a curved surface. It features capacitive touch, facial recognition and low energy consumption. The Portal's central display includes embedded voice control and integrated vehicle-to-everything (V2X) use cases.

### **Lima 2nd Generation e-Cockpit Showcase**

The hallmark of our Lima e-Cockpit Showcase is that it demonstrates the concept of an e-Cockpit with four main areas of information and control distribution: driver, shared central, front passenger, and rear seats.

While the 1st generation Lima boasted a door-to-door display area with a monolithic aspect ratio, our 2nd generation includes an advanced 3D digital cluster with a large central information display (CID). The CID features local dimming capability - that increases the contrast and legibility of information and side displays - for interior control and the possibility of an e-mirror. An on-board digital fingerprint sensor detects identifiable users. A complementary small display offers the driver contextual information and a simple reconfigurable control panel. For additional comfort and safety, the driver can use a unique “Butler” controller located on the central console, featuring a touchscreen with reconfigurable rotary and haptic feedback. The passenger area is equipped with a display featuring a privacy function.

The HMI allows for information to be distributed to any of the displays (with contextual functionality) and provides the user with optimal interaction and perception. Rear seat passenger entertainment is available through a dual display allowing for content to be watched (head rest) or enabling more interaction (back rest).

Our camera-driven monitoring system determines driver awareness and reinforces the empathy of the HMI to the driver.

### **Janus Multi-Display e-Cockpit with Hypervisor Technology**

Our Janus e-Cockpit Showcase integrates a single ECU capable of managing the cluster display and CID. The cockpit ECU can be installed anywhere in the dashboard allowing for flexible styling of the displays. The system embeds a hypervisor running both Linux® for infotainment and a real-time operating system for the cluster.

The Janus combines our Portal Showcase and 27” Cockpit Display experiences to provide a dual AMOLED display assembled on complex glass (curved and flat) with touchscreen functionality. An additional “Butler” display enhances the cockpit control for the driver or the passenger (depending upon orientation ) and offers controls to increase comfort and driving safety (the display can be rotated to change modes). Distribution, responsiveness, and adaptation are the highlights of this HMI.

### **Cardea Multi-Display Android™-based e-Cockpit with Hypervisor Technology**

Our Cardea e-Cockpit Showcase is a new solution developed using the Android automotive operating system. It integrates a single ECU capable of managing the cluster display, CID, and separate control display. The ECU is disassociated from the displays and can be installed anywhere in the dashboard.

Cardea is based on our Janus Display Showcase featuring two AMOLED displays assembled on complex glass (curved and flat) with touchscreen functionality. An additional “Butler” display enhances the cockpit control through touchscreen and rotary buttons to increase comfort and driving safety (force-sensing and haptic feedback allow the driver to keep their eyes on the road).

### **3Djinn Glasses-Free 3D Display Showcase**

3Djinn demonstrates Magneti Marelli’s new glasses-free 3D display technology. A cluster is shown through small five-inch 3D displays combined with a reflective black lens on top. Information is shown in a 3D scene, depicting objects in depth and elevation, allowing for more natural and hierarchically organized layers of data.

Under the cluster an amazing optical system projects images in the air generated by the 3D display. To reinforce the floating virtual object perception, the user can interact with the system by simple gesture. This combination of displays and interaction illustrates Magneti Marelli's capacity to develop disruptive user interfaces for the automotive market.

### **27" Cockpit Display Showcase**

Our 27" Cockpit Display Showcase is a cost-effective platform, fully developed by Magneti Marelli China, to support accelerated in-vehicle electronics growth in the local market. Made of two high definition (HD) screens bonded under treated (anti-glare, anti-reflection, anti-fingerprint) Corning Gorilla Glass for Automotive Interiors, this display shows a possible floating integration inside the cockpit. Depending upon consumer architecture, Magneti Marelli's digital cluster platform can address single or multiple ECU integration.

### **12.3" HD Full Digital Instrument Cluster**

The latest addition to our digital cluster portfolio is the 12.3" HD full digital cluster, optimized to improve performance while keeping costs down, without compromising the user experience. The cluster is enhanced by high resolution screen support, rich 3D HMI content, and meets the connectivity requirements of our latest digital cluster platforms (multi-connectivity support, scalability, cyber-security).

### **Windshield Heads Up Display (HUD)**

To highlight the scalability of Magneti Marelli's digital cluster platform, our HUD demonstrates our platform's ability to drive multiple screens. Our windshield HUD was designed in-house, and matches real windshield glass with up-to-date performances in terms of length of projection, field of view, and angular resolution.

### **Multiple OS e-Cockpit with Hypervisor Info-Cluster**

This technology allows different domains, traditionally powered by specific ECUs, to be merged together inside a single system on chip (SoC), maintaining the same level of reliability and quality of service.

It enhances the end user experience by centralizing the management of up to four displays and empowering their rendering with up to eight camera inputs, while offering multiple ways to interact, through Magneti Marelli's reMMoT App, for example. Our single piece S-shaped cover lens hosting two 12.3" HD displays demonstrates the next step in screen integration inside the cockpit.

### **Polablack™ Innovative Black Panel**

Black panel technology is not new: its light blocking properties remain constant whatever its state.

What makes Magneti Marelli's Polablack technology unique, is its ability to unify dark rendering in an OFF state, while at the same time offering a high transparency ratio in the ON state (+40% versus traditional solutions). This versatile behavior allows for implementation of this highly appreciated look and feel, with a design that's very close to a traditional 'non-black' panel solution. Polablack is beneficial not only in terms of reliability (gives off less heat) but in efficiency as well.

The Polablack application seen at CES is an 8" display surrounded by two satellites. It features a colored

ambient light effect that provides the realistic feel of a 12.3” screen in both the OFF and ON states. The seamless design delivers the ‘wide-screen feeling’ without compromising reliability (scratchproof) or readability (anti-glare).

### **R-Touch™ Full Digital Cluster Showcase**

This 12.3” HD full digital cluster offers intuitive, user-friendly reconfiguration using R-Touch technology, and is hosted in our digital cluster platform. It pairs with companion apps running on any smartphone. This showcase is designed around a 12.3” HD display bonded under treated mineral glass (anti-glare, anti-reflection, anti-fingerprint). The first application from this multi-awarded platform started production in 2018 for the Chinese market.

## **POWERFUL PERCEPTION TECHNOLOGY**

We integrate cameras, sensors and perception software to provide driver monitoring functionality - and soon - in-cabin monitoring. Monitoring is important not only for safety, but for comfort and interaction. Perception systems can allow vehicle occupants to control functions with the wave of a hand, while our monitoring system can determine if a driver is fatigued or inattentive. In an autonomous driving scenario, our technology can perform object detection, identify drivable areas, and recognize road signs, using deep learning algorithms similar to the ones used for in-vehicle functions.

### **Driver Monitoring**

There’s no shortage of potential applications for facial recognition technology within a vehicle. Leveraging an in-vehicle camera to scan the driver’s face, facial recognition software captures personal preferences to adjust the car’s settings each time the driver climbs behind the wheel. This individual profile could include favorite radio stations or a music playlist, specific instrument cluster and display settings, and seat and mirror positions.

While many companies are introducing driver monitoring applications to support autonomous and connected vehicles, Magneti Marelli’s facial recognition solution is different in that it requires very little computing power and works without complex hardware. Our camera monitoring system captures infrared images of the user and provides real-time information such as identity, face position, gaze direction, eye open level, blink speed and frequency, and other discriminant features to determine user status and mood. We’re able to interface this metadata output with our HMI to dynamically adapt the car’s environment. Magneti Marelli is working to extend this technology to supervise not only the driver but the rest of the cabin.

### **Perception Demo**

Magneti Marelli will demonstrate its software perception capabilities in the context of a future advanced driver assistance system (ADAS). We are addressing the complete perception software technology chain, from simulation and generation of training sets allowing for:

- Limitless training sets of data to be automatically annotated, giving us the ability to “virtually” drive for billions of kilometers
- Perception algorithm development using the best neural network pre-selection and training, providing precise 3D environment object positioning and tracking

These steps are then automatically and optimally deployed on defined hardware platforms to be tested against our unlimited virtual dataset or any real measured dataset.

## INSTRUMENT CLUSTERS

No longer a simple depiction of speed and fuel level, the vehicle dashboard is evolving thanks to advancements in electronics and digital displays. Once reserved only for premium vehicles, digital clusters are becoming smaller in size and weight and are making an appearance in low to mid-range vehicles. As cars become “smart”, digital displays will be mandatory in order to display the navigation, infotainment and connectivity features consumers demand.

Far from a niche supplier, Magneti Marelli provides a full-range of low, medium, and high-end instrument clusters, with the ability to customize to specific market needs based on OEM requirements. Our complete product range includes analog, hybrid, and full digital clusters, leveraging our expertise in hardware and software development, mechatronics, optics, and screen printing.

### **Renault KWID Entry-Level Instrument Cluster**

This cluster was developed through a collaboration of our R&D centers in Brazil and India, and is dedicated to low-end market segments. It has been designed to be highly efficient in terms of materials used, while well-equipped with features such as analog gauge indicators, an LED eco-drive indicator, a helpful gear shift indicator (GSI), and trip computer.

### **Suzuki Vitara Brezza 3.5” Display**

Magneti Marelli supplies the all-new 3.5” LCD instrument cluster for this compact SUV. It features aesthetic functions such as “mood lighting”, which allows drivers to select from five colors depending upon their mood. The cluster completes the unique cockpit style, is equipped with flat top bottom dials, and is connected to the parking sensor system.

### **FIAT® 500X 3.5” Color TFT Instrument Cluster**

One of the biggest innovations of the new 500X is its completely restyled cockpit. It features the typical three rings with a 3.5” thin-film transistor (TFT) color display instrument cluster, with easier to read graphics and innovative style solutions such as a new pointer design and vinyl effects on the dials.

Data acquired from the new Traffic Sign Recognition system, as well as information from the infotainment and navigation systems, is sent in real-time to the instrument cluster display.

### **Jeep® Wrangler™ 7” Color TFT Instrument Cluster**

This instrument cluster features a 3.5” or 7” TFT LED information display. The 7” display, offered standard on the Sahara™ and Rubicon™, is full-color and allows the driver to configure information in more than 100 ways. The hand-wrapped instrument panel, well integrated in the heritage-inspired cockpit of the vehicle, features a soft-touch surface with accent stitching on the Sahara model.

**PSA PEUGEOT 3008 and 5008 i-Cockpit® 12.3” “High-End” Full TFT Color Instrument Cluster**

Magneti Marelli's 12.3" fully reconfigurable TFT cluster was developed and produced to fulfill Groupe PSA's requirements for their PEUGEOT SUVs. The cluster combines high resolution images with graphics capabilities and features normally white technology, 3D graphics, and integrates with the navigation system mounted on Magneti Marelli's 8" CID. This high-end technology is now available for high-volume production.

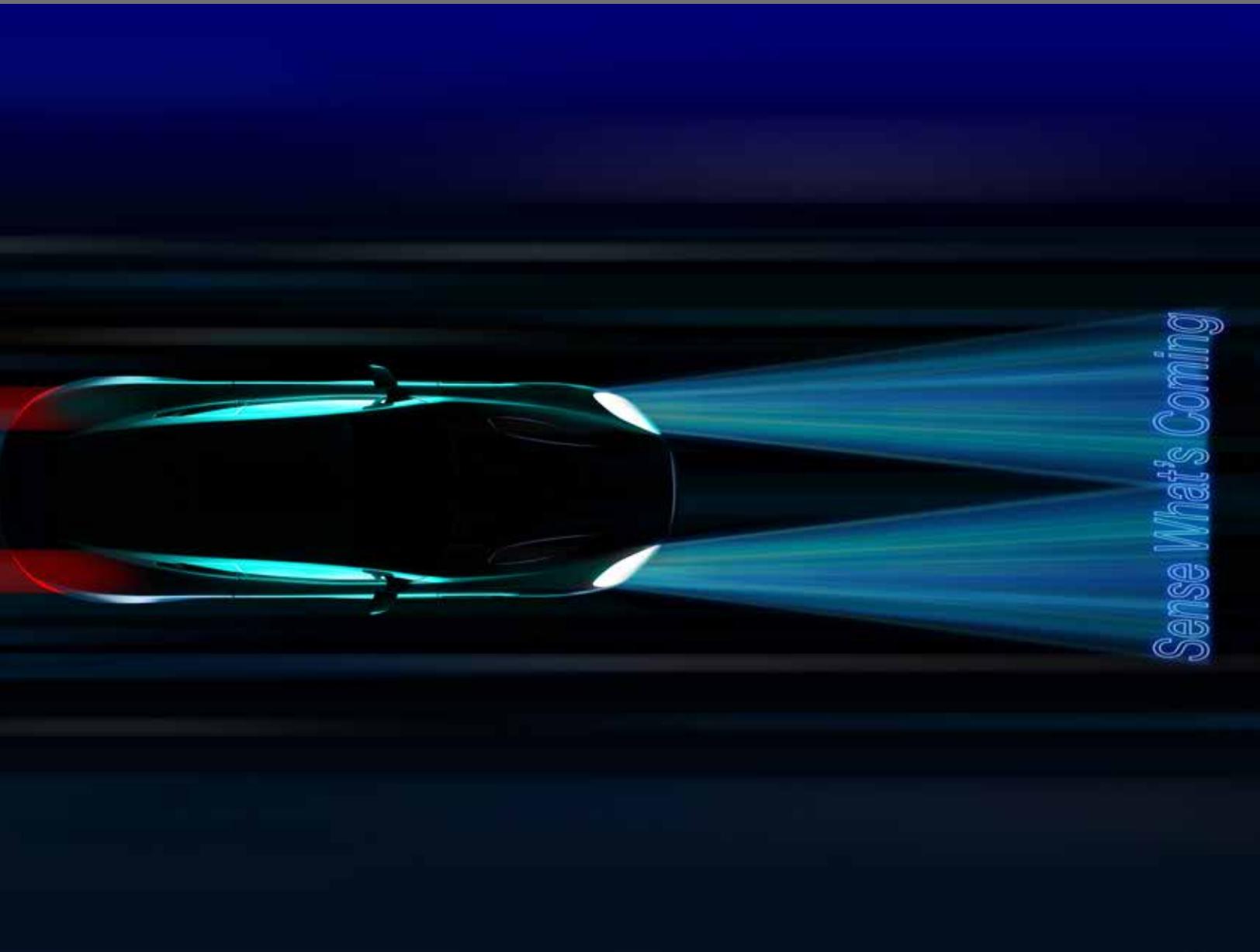
**Porsche 911 GT3 RS™ “Tailor-Made” Luxury Instrument Cluster**

Magneti Marelli supplies its “tailor-made” instrument clusters for Porsche. The Porsche 911 GT3 RS features our instrument cluster with the iconic circular element design and a reconfigurable extra bright 4.6" TFT display. The cluster displays all useful information for the driver, supported by two additional matrix displays. We produce more than 500 variants of this cluster in sequence.

**SAIC Roewe eRX5 12.3” Full HD TFT Display**

This full digital cluster is one application based on our platform developed specifically for SAIC. Using the latest HMI rendering technology, its high definition TFT display provides an immersive experience through a 3D birds-eye view map and advanced ADAS information, and ensures the onboard information rendering as well, as expected in a new energy vehicle.

# LIGHTING



Sense What's Coming

The Automotive Lighting division of Magneti Marelli is focused on developing advanced lighting solutions to make our roads safer. A recent study conducted in Germany reported that nearly 5,000 nighttime traffic fatalities were recorded in 1991. By 2017, that number had decreased to fewer than 900, a reduction of more than 80%. A key contributor to this trend is headlamp performance, and as a leading supplier of the most technologically-advanced lighting on the road today, we're intent on driving this statistic down even further.

#### **Our solutions:**

##### **Use light as a perception and communication tool**

We were first to market with digital light processing (DLP), the world's first 1.3 million pixel production headlamp. DLP creates ideal lighting conditions, and can project images onto the road to communicate with drivers and pedestrians.

##### **Increase visibility for a safer, more comfortable drive**

Our portfolio of Adaptive Driving Beam (ADB) solutions is impressive, and just keeps growing. ADB technology gives drivers high-beam visibility while eliminating glare for oncoming and preceding traffic. Headlamps equipped with ADB can operate in high beam mode nearly 100% of the time, providing maximum light output. Thanks to a winning combination of laser and LED light sources, our latest generation laser headlamps have a high beam range of more than 600 meters.

##### **Make advanced lighting technology affordable**

Safer headlamps shouldn't be reserved for high-end vehicles or only drivers who can afford them. In an effort to provide advanced technology at a lower cost, we're developing standardized, LED-based solutions that provide universal ADB in a compact module. These high-end alternatives contain fewer components than traditional ADB modules which helps to keep costs down.

## **STANDARD LED MODULES**

### **c-Light**

Our c-Light is an efficient, robust, and compact optoelectronic LED module. It uses collimating optics, a mirror shutter, aluminum heat sinks and glass lenses as secondary optics. The c-Light is a low-cost, halogen replacement available with or without an integrated LED driver, and targets entry-level vehicle segments with its low price tag. It provides low beam and high beam functionality with lumen output of 500 and 350, respectively.

### **f-Lux**

Not a traditional module, our f-Lux concept is a standard light source consisting of PCB-mounted LEDs, a connector and a heat sink. Leveraging a reflector rather than a projector, it is a low-cost halogen replacement and is scalable - available in two-chip, three-chip or four-chip LED configurations. OEM styling needs and performance requirements will dictate the use of a two, three, or more chamber module. The f-Lux can achieve an IIHS "good" rating, which is difficult to attain with a reflection system.

### **s-Light**

Our scalable s-Light comprises a family of optical LED modules that address OEM demand for increased functionality within tight space constraints. True to its name the s-Light achieves three “s” targets, it’s short, small, and slim. The module uses a projector combined with an inner reflector to optimize space; it is just 135mm deep (max) with a 40mm lens height. Unique to the s-Light is its flexible design. It is available as a single function low beam or high beam module, as a bi-function module with low and high beam, or low beam combined with ADB.

### **Best Cost Matrix (BCM)**

In response to market demand for ADB technology at a lower cost, we’ve developed our Best Cost Matrix (BCM), a compact, simple solution with fewer components than other ADB modules. The BCM is a single-row, eight segment LED projector, with passive cooling. It provides good light homogeneity (intensity and color), with a 500 lumen output per module. The reflector can be adjusted to the headlamp in terms of height and width, providing styling flexibility.

### **m-Light**

Our m-Light was developed specifically to provide ADB functionality, and is designed to be paired with a separate low beam module. There are four module options in the m-Light family: a single row LED solution that produces 12 or 16 segments, and a two-row solution with 24 or 32 pixels. For OEMs who prefer a two module solution to meet styling requirements, the m-Light could be an ideal choice. Multiple vehicle segments can be addressed with a combination of modules; for example, a base version vehicle could be equipped with a single bi-function s-Light for low and high beam, while a premium version of that same vehicle could include a single function module for low beam (s-Light) paired with an m-Light for ADB.

### **PHB 84 Pixel**

Our PHB 84 Pixel ADB module boasts 84 LEDs, making it capable of providing a much higher resolution than other ADB modules, much like the difference between watching a standard TV and an HDTV. It provides low beam, high beam and ADB functionality in one all-encompassing unit. The PHB is a high-end, premium vehicle solution capable of generating various light patterns such as town and highway light, and Adverse Weather Adaptation, in addition to high-level ADB functionality. The PHB 84 Pixel technology can be seen in the Mercedes-Benz S-Class and Porsche 911 vehicle headlamps.

### **Laser**

We bring laser high beam modules to a new level, optimized and suitable for adaptive headlamp functions such as dynamic curve light and glare-free high beam. With onboard electronics for laser function control and passive cooling, and in combination with LED high beam, our laser module enhances the beam of light to 600 meters using just one laser chip, while drawing minimal power. Laser diodes (one per module) create a very high light intensity resulting in wide reach, while occupying minimal space in the headlamp.

## HEADLAMPS

### **Matrix Headlamp with Double Projection (Audi A5)**

Our intelligent all-LED matrix headlamp, as seen in the Audi A5, features an 800 lumen low beam powered by seven LED chips. Our high beam is precise, camera-controlled, glare-free, and capable of achieving 1800 lumens on the road, while our “four-eye-design” provides perfect light homogeneity. The daytime running lights (DRL) are indicative of Audi’s signature styling, and serve as a positioning lamp when dimmed to 10% power. The headlamp boasts a progressive turn signal powered by nine LED chips that underscores the dynamic character of the vehicle.

### **First Adaptive All-LED Headlamp with Multi-Color Chips (PSA DS7)**

Functionality and design, so essential for a headlamp, unite in the adaptive all-LED headlamp of the Citroen DS7. The so-called “Magic Movement” of three U-shaped reflector modules is what brings the headlamp to life. Illuminated by multi-color (RGB) LEDs, the lamp provides truly eye-catching functionality. The principle of “Magic Movement” provides our customers flexibility: various animations are possible, and parameters such as illumination times and movement duration can be individually adjusted according to specific requirements. With the help of stepper motors, the reflectors are able to turn 180°, providing not only attractive welcome function features but also contributing to adaptive light distribution.

### **Camera-Controlled Intelligent LED Headlamp with Glare-Free Laser Spot (BMW 8)**

Automotive Lighting has developed a laser headlamp capable of generating glare-free laser high beam for the all-new BMW 8. The combined double projector/reflector is partially surrounded by 3D light guides with pinstriped walls, producing the brand’s iconic daytime running light (DRL). The projectors generate the low beam while the reflectors mounted below emit the high beam, supported by the fully integrated high power laser. When oncoming or preceding traffic is present, the outboard modules (including the laser spot) swivel apart, creating a glare-free gap. The swiveling function is also used to create the dynamic curve light.

### **Digital Light Processing (Mercedes-Benz Maybach)**

Another first to series production is our 1.3 million pixel digital headlamp for the Mercedes-Benz Maybach. The headlamp incorporates a digital light module called h-Digi, combined with our PHB 84 Pixel module. The technology known as digital light processing (DLP) uses DMD (digital mirror device) units. Illuminated by three LED chips, the 1.3 million micro mirrors (per headlamp) project light patterns onto the road. The result of DLP is ideal lighting conditions with an extraordinarily flexible light distribution, capable of casting light in tighter proximity around oncoming vehicles than ever before. As an additional safety feature, images conveying “keep to your lane” or “watch the maximum speed” can be projected in front of the car in order to warn or inform the driver. The driver can also communicate with other drivers or pedestrians, by projecting messages intended specifically for them.

## TAIL LAMPS

### **Homogenous High Density Light Curtain (Honda Accord)**

This rear lamp features an innovative concept consisting of LEDs in a high density light curtain with micro-optics that provide a homogeneous look on the fender and trunk lamp when lit, and a clear look when turned off. The stop function is created by LEDs in multi-cavity reflectors that aim the light in different directions to fulfill government regulations. The turn indicator and reverse functions are powered by incandescent bulbs.

### **Flexible Functionality Behind a Light Curtain (Prototype)**

Our brand new prototype features all-LED lighting, light guides, and micro-optics, to create the tail and stop functions within an optimized package. The tail lamp consists of a high density light curtain that provides a homogeneous look, while behind the light curtain we include light guides to provide the stop function. The turn indicator is created by using shell reflectors with yellow LEDs visible through the red lens.

### **OLED Alternative (Folia LED)**

Automotive Lighting is working on new optical solutions that can be used as long lasting, low-cost alternatives to organic light emitting diodes (OLEDs). Our Folia LED provides a homogenous look similar to the appearance of an OLED. The concept, which consists of individually addressable LEDs behind an optical system of light curtains and filters, provides a superior appearance in a thin package. The efficiency of the concept allows the Folia LED to be used as a tail lamp, stop lamp, and turn signal. Because the LEDs are individually addressable, this new concept is perfect for animations and segmented functions such as welcome lighting and wiping turn signals.

### **Splendid 3D Effects (PSA DS7)**

This tail lamp features an impressive combination of crystals combined with a novel process of partial demetallization by means of laser. The light reflected by the partially demetallized bezel shines through the crystal-clear pattern creating amazing sensual shapes. Ultra-red LEDs are used for the tail and stop functions, and the amber turn signal LEDs shine in a progressive way highlighting the turn direction.

### **Thin Blade Technology (Porsche Cayenne)**

The tail function for Porsche's full-body trunk rear lamp, measuring nearly 1400mm wide and consisting of 270 LEDs, is based on a "thin blade concept." This novel optical solution provides excellent homogeneity due to a spherical caustics pattern and without any diffusion materials. A laser welding process is used for the housing and outer lens.

## LIGHTING ELECTRONICS

### **Holobox with Electronic Control Units for Laser and Digital Micromirror Device (DMD)**

See first-hand an example of our electronic competence with a focus on laser and digital light, complete with a holograph featuring our latest video.

**Electronic Control Units:  
Headlamp Control Module (HCM)**

The HCM control unit is designed to support features of innovative headlamps with LED light sources. The HCM supports light functions such as pixel light, matrix patterns or laser high beam, and adaptive functions such as static bending light or dynamic curve light. This control unit also enables the use of actuators such as fans (for thermal management) and stepper motors (Automatic Vertical Aim Control/ AVAC). The HCM uses two Controller Area Network (CAN) channels that enable communication with the front camera and vehicle, while a sub-CAN interface provides communication between the headlamps. One Local Interconnect Network (LIN) channel transmits commands coming from the Body Control Module (BCM).

**Driver LED Compact (DLC)**

The DLC control unit is designed to control up to two LED chains in a headlamp. Two basic assembly options are available, the DLC 1.5 with one LED channel, and the DLC 2.5 with two LED channels. The low and high beam functions are controlled by means of the first channel with a short switch. The daytime running light (DRL)/position light (POS) function is controlled via channel number two.

**Pixel High Definition (PHD)**

The PHD control unit is designed to support features of innovative headlamps with LED light sources. In addition to supporting light functions it enables the use of actuators such as two fans (for thermal management), one stepper motor (AVAC), communications (two sub-CAN-FD) and signals. The supply and control of outsourced light functions such as 84 Pixel array, DLP, and an ultra-range high beam (URHB) are also provided.

**Front Lighting Module (FLM)**

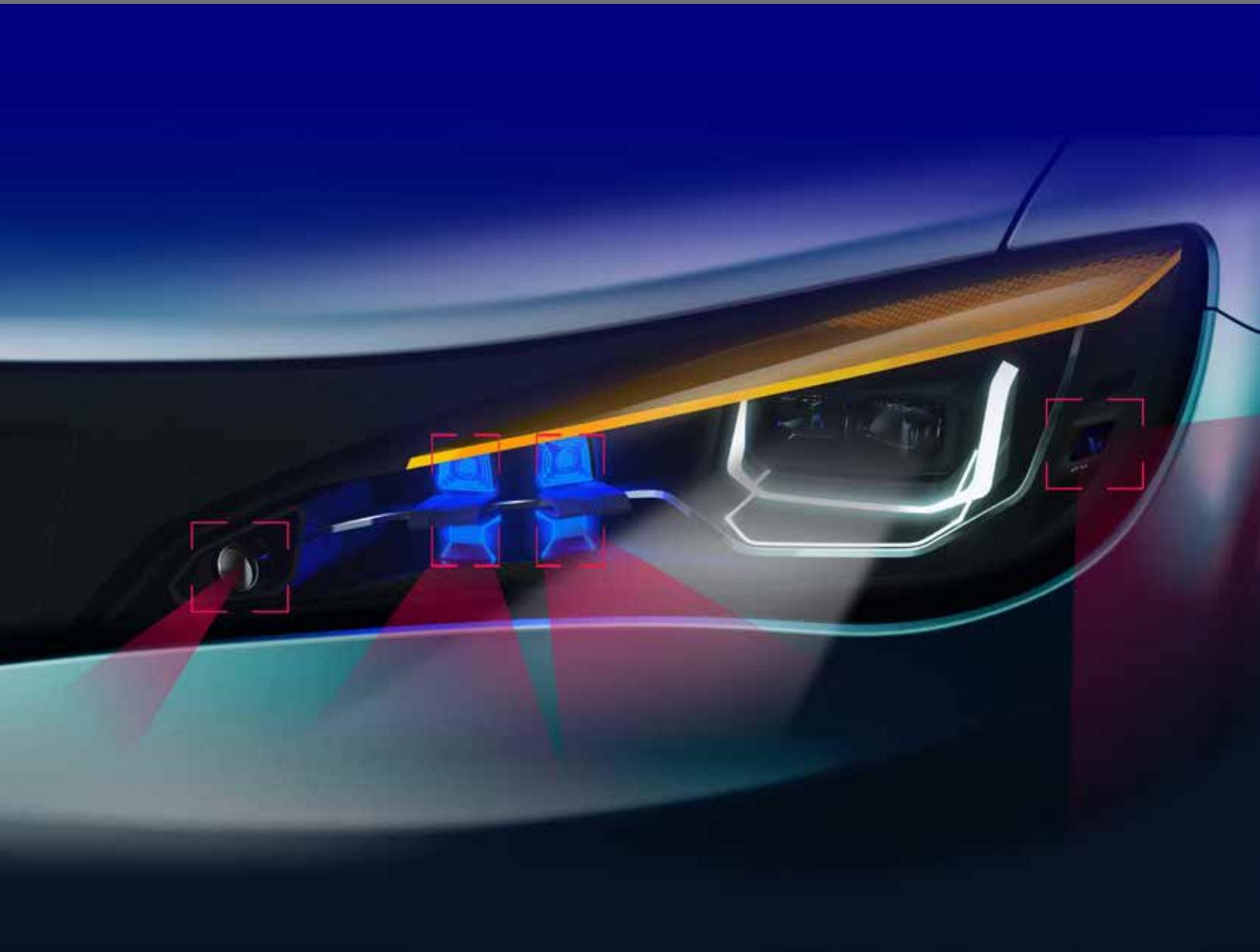
The FLM control unit is designed to support features of innovative headlamps with LED light sources. It supports several light functions including laser light with 12 LED channels and adaptive functions such as dynamic bending light. This control unit also enables the use of actuators such as fans (for thermal management) and stepper motors (Automatic Vertical Aim Control/AVAC and Dynamic Bending Light/DBL). The FLM uses one Controller Area Network (CAN) channel that enables communication with the vehicle and one optional Local Interconnect Network (LIN) channel to control LIN slaves in the headlamp. The ECU has one single power supply connected to permanent battery voltage and controls all light functions with the help of CAN messages including a Wake-Up-Over-CAN feature. Additionally a signal input line is available to synchronize the turn indicator control. The software is based on an AUTOSAR 4 stack.

**Digital Light Processing (DLP)**

DLP is a projection technique in which images are generated by modulating a digital image onto a light beam. In this case, the light beam is divided into pixels by a rectangular arrangement of movable micromirrors and then reflected pixel by pixel either into the projection path or out of the projection path.

Our DLP control unit is designed to control and operate the digital micromirror device (DMD). Functions are implemented which support the necessary thermal management and monitoring of the DMD. The DLP uses a Controller Area Network (CAN) bus, and the video signal is transmitted serially via a low voltage differential signaling (LVDS)/high speed video link (HSVL) interface.

# AUTONOMOUS & CONNECTED VEHICLE





The Automotive Lighting division of Magneti Marelli brings more than 100 years' experience in exterior lighting design and development to enable high-performance lighting solutions for OEMs worldwide. Leveraging this expertise, our innovation team is developing solutions to support advanced driver assistance systems (ADAS) and autonomous vehicle technology that extends beyond the lighting realm.

## EXPERTLY INTEGRATED SENSORS ENABLE AUTONOMOUS DRIVING WHILE MAINTAINING STYLING AESTHETICS

### Smart Corner™

Our Smart Corner was named a **CES 2019 Innovation Awards Honoree**, in the Vehicle Intelligence & Self-Driving Technology category. Smart Corner integrates autonomous sensors into headlamps and tail lamps to provide OEMs with the required functionality for autonomous driving, while maintaining styling aesthetics and world-class lighting performance.

Our third generation Smart Corner will be unveiled at CES 2019, and represents the progress we've made in developing this flexible platform. Smart Corner can accommodate any sensor an OEM may choose to deploy, including LiDAR, radar, cameras, or ultrasonics, as well as advanced, LED-based lighting features like adaptive driving beam (ADB) and digital light processing (DLP).

Smart Corner provides a 360° view around the vehicle with redundancy. Because the sensors are integrated into existing headlamps and tail lamps, an OEM benefits from a fully calibrated, plug-and-play solution, resulting in a simplified manufacturing process that's lower cost and lighter weight than alternatives.

### New Functionality:

- **FIR (Far Infrared) Thermal Cameras** - deliver better object detection and classification than do traditional cameras, as they sense an object's thermal heat signature for accurate, reliable detection even in inclement weather or dynamic lighting conditions. This sensor may play an extremely important role in both ADAS and autonomous driving applications. FIR can also be combined with a HUD to give the driver a detailed scene of the road. Our third generation Smart Corner incorporates FIR thermal cameras from AdaSky.
- **Light Fidelity (LiFi)** – is incorporated using the existing LEDs in our Smart Corner headlamps and tail lamps. LiFi provides vehicle-to-everything (V2X) functionality using light to transmit data. LiFi ensures data rates stay consistent if the WiFi signal drops, and is faster and more secure than WiFi, as it requires a direct line of sight for data to be intercepted. We've partnered with French LiFi pioneer Oledcomm to provide their latest LiFiMax® modem for our Smart Corner.
- **77GHz Corner and Forward-Facing Radar** - we have integrated Aptiv's state-of-the-art corner and forward-facing radar, capable of detecting objects up to 150 and 250 meters, respectively. These devices are smaller and more powerful than the radar currently available on the market.

- **LCA2 Auto and Mobility LiDAR Platform** - LeddarTech's LCA2 LiDAR platform has been integrated to provide corner, short range, object detection. This versatile Solid-State LiDAR platform enables the design of a scalable LiDAR solution meeting functional safety requirements, and is automotive grade for ADAS/AD applications.
- **mmWave Radar** - enhanced short range object detection replaces the ultrasonic buttons on the exterior of the vehicle. This small electronic device, developed by Mediatek, can be packaged easily inside the Smart Corner and can provide object detection beyond 10 meters. This technology will allow OEMs to reduce cost and weight while improving aesthetics.
- **Audible Alerts/Sound Generation** - innovative speaker technology developed by Tectonic Audio Labs, utilizes the membrane of the Smart Corner lens or housing and can be easily packaged to provide external sound capability for communication or emergency needs. A microphone can also be included to listen and provide localization/mapping for geolocation in tunnels or areas where there may be poor GPS signals.
- **HDR Camera** - to supplement the 360° view, new cameras from Magneti Marelli's Automotive Lighting division are installed at the corners of the vehicle to achieve required view angles.
- **Cleaning System** - if a sensor is dirty, dusty, or covered in snow or ice, it won't function correctly. By incorporating all Smart Corner sensors behind the lamp lens, we only need to be concerned about keeping the lenses clean. We've developed a liquid washing system, combined with forced air, to keep the lenses clean and sensors functional. We've incorporated a durable low surface energy coating from Alchemy, to be applied during lens manufacturing, to repel dirt, dust, and frost. An integrated heating element melts snow and ice, and eliminates inner fog.

## SEAMLESSLY INTEGRATED CONNECTED VEHICLE TECHNOLOGY

Inspired by the modular approach of our Smart Corner, we've developed connectivity features that are seamlessly integrated into our test vehicle, such as:

### Exterior Communication Panels

As an extension of our Smart Corner concept, we've integrated AMOLED displays into the front grille and rear applique of our test vehicle to extend the ability to signal and communicate across the front and back of the vehicle.

With the advent of autonomous driving, it will be crucial to signal vehicle intent to pedestrians, bicyclists, and other vehicles. We can convey a variety of messages for safety, security, and advertising (when the vehicle is parked). Examples could be weather alerts, road information (speed limit or hazardous conditions), emergencies (amber alerts), or paid advertising. The bright AMOLED displays allow the messages to be read easily during daylight hours.

**Autonomous Signaling**

Visible turquoise light on the exterior of our test vehicle communicates to others that the vehicle is in autonomous mode.

**Exterior Virtual Assistant**

In conjunction with SapienX, we've developed a conversational external HMI, leveraging voice commands and a 2D avatar projected in the rear window of our test vehicle. Using the integrated Smart Corner sensors to identify when a person is approaching the vehicle, the avatar can perform commands for the driver and passengers such as opening the trunk or unlocking the doors.

**Positional Advertising using V2X Connectivity**

Autonomous vehicles will interact with people and products, which presents an opportunity to create potential revenue streams. We've developed a means to provide targeted advertising to individuals based on micro-location, which can be further enabled by 5G. Using the car's location, ads can be projected onto the windows, turning it into a billboard on wheels.

**Light Projection and Gauzy Liquid Crystal Technology**

To support our exterior virtual assistant and positional advertising functionality, we are developing high power projection and film technologies. Both can be packaged on the vehicle interior, and as part of the window glass, to achieve a viewable, high quality image from outside and inside the car. Our partner, Gauzy, has excellent LCG (light controlled glass) technologies to improve images and help keep the vehicle cool, reducing energy demand from the vehicle battery, while allowing windows to change from transparent to opaque on demand.

Light as a communication tool?  
**Now you're speaking our language.**



Digital Light Processing  
*Sense What's Coming*  
We're Closer Than You Think ...

MAGNET  
MARELLI

Content when and where you want it?  
**We're just scratching the surface.**



Advanced HMI Solutions  
*Sense What's Coming*  
We're Closer Than You Think ...

MAGNET  
MARELLI

Perception is everything.  
**Stay awake, alert and in control.**



Driver Monitoring Systems  
*Sense What's Coming*  
We're Closer Than You Think ...

MAGNET  
MARELLI

Headlamps that do more than  
light the way?  
**Now that's smart.**



Smart Corner™  
*Sense What's Coming*  
We're Closer Than You Think ...

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