Introducing the next-generation of rain light sensing

Automatic wipers have become virtually ubiquitous in high-end vehicles, but how can manufacturers circumvent the challenge of false wipes?

A popular feature in most modern premium vehicles and in many medium-class models in Europe and Asia, the rain light sensor's initial uptake can be attributed to its status as a comfort function. Subsequently it also has been viewed as an important safety device. The correct wiper speed ensures good visibility in all conditions. Car manufacturers also view the rain light sensor's location behind the rear-view mirror as ideal for a cluster of sensors, such as humidity, sun position and ambient temperature. Many rain light sensors already assess light levels, relaying that information to an ECU to enable automatic headlight control. This feature is also seen primarily as a comfort function, with an ECU taking over the decision from the driver to illuminate headlights in changing weather conditions, during dawn and dusk driving, or at the entrances and exits to tunnels.

The rain light sensor is an opto-electronic system that generally consists of LEDs, photodiodes, a microcontroller and the necessary control circuitry. An optical sensor with a near infrared (NIR), light emitting diode located just behind the rear-view mirror sends an infrared beam onto the back side of the windscreen. If there's no rain on the glass, the windscreen reflects 100% of this NIR light back into a receiving photodiode, but when rain falls on the glass, the difference in the amount of reflected light allows the rain intensity to be calculated.

While the rain light sensor system works well in lab conditions, the sun is a major disturbance factor in commercially available systems. For example, when the driver navigates round a roundabout, the sun can swiftly cross the windscreen from side to side, creating an optical effect that results in false wipes. On a dry windscreen the wipers will quickly degrade.

Until now, it has been a considerable challenge for manufacturers of rain light sensors to avoid disturbance from the sun. Either the system has to ignore signals or wait to do a double or triple check, making the system less responsive. Among the alternatives is a delicate optical system with special waveguides to monitor the raindrops, which is both complicated to integrate and expensive.

A solution is to enable the system to split the sun component from the rain component. Melexis' rain light interface chips, the MLX75308 and MLX75310 differentiate between rain and errant sun signals. This allows the ECU to make the appropriate decision.

The rain light interface chip can be found just behind the rear-view mirror. This is the best place to monitor rain without compromising the driver's field of vision. The Melexis rain sensor interface chip sits next to the microcontroller for the rain light sensor module. The rain light sensor module is connected to one of the vehicle's ECUs for controlling comfort

and safety systems. The MLX75308 and MLX75310 handle the LEDs that emit the IR beam into the windscreen, the photodiodes that receive that light, as well as photodiodes that detect general ambient light conditions. Melexis interface IC acts as the master, splitting the signals and sending them over SPI to the microcontroller on request. This removes much of the computational burden from the microcontroller and makes the system design much easier.

Manufacturers often have their own dedicated rain sensing algorithms. By presenting the signal data to the microcontroller on-demand and in a digital form, Melexis ICs enable Tier 1 and OEMs to implement their own algorithms on the microcontroller to determine exactly how this data should be handled.

Contrasting with the individuality of rain sensing algorithms is the demand from OEMs for a rain sensing system that works across different car platforms. This means that the system needs to be flexible enough to cope with a wide variety of windscreen angles (windscreens span 40° to 90° angles) and different shades of windscreen tinting, from those that are very black to those that are crystal clear. Sensor interfaces need the additional bandwidth to cope with multiple sensors, enabling high-end manufacturers to integrate sensors that will cover a larger area of the windscreen in order to sense the slightest raindrop. Melexis' MLX75308 is programmable, versatile and offers a high dynamic range, enabling it to cope with the full spectrum of light levels (day or night), windscreen angles and shades of glass.

When integrating rain light sensors, other design criteria include size and performance. The MLX75308 is being made available in a new generation leadless QFN package, measuring just 4 x 4mm. With an external led driver (MLX75308) or internal led driver (MLX75310), Melexis offers flexibility to choose the most suitable option for the system.

Melexis has raised the performance bar when it comes to rain light sensing. With its combination of optical and automotive mixed signal design expertise, the company has tackled a technical challenge for automotive manufacturers in an easy-to-integrate and cost effective way.