White Paper

UPC842AMP: Automotive Single Power Supply, High-Speed, and Wide Band Dual Bipolar Operational Amplifier

November 2019

Abstract

Renesas has a broad analog component portfolio providing a wide range of next-gen precision instrumentation, medical, communication, and industrial process control applications. With this portfolio, high-performance and high-precision sit alongside innovation, reliability and dependability as central to the analog design. Renesas' operational amplifiers (op-amp) are among the industry's highest-performance, highest-value amplifier ICs on the market.

Just within the past year, we have seen a significant step forward in car technology with a number of manufacturers turning to the latest technology for vehicle improvement and partnering with chipset manufacturers to make their cars smarter, safer, and more entertaining.

This indicates that op-amps are becoming more crucial in providing higher-speed amplification to the chipset, especially since sensors inside the car need more sensing for higher safety and protection margins.

Wide Range Sensors Application

Renesas Op-Amp is able to support a variety of sensors inside a car as show in the diagram A below. The criteria of the op-amp to support these sensors is the need for high-speed response during signal amplification and high stability to ensure signal precision at the output.

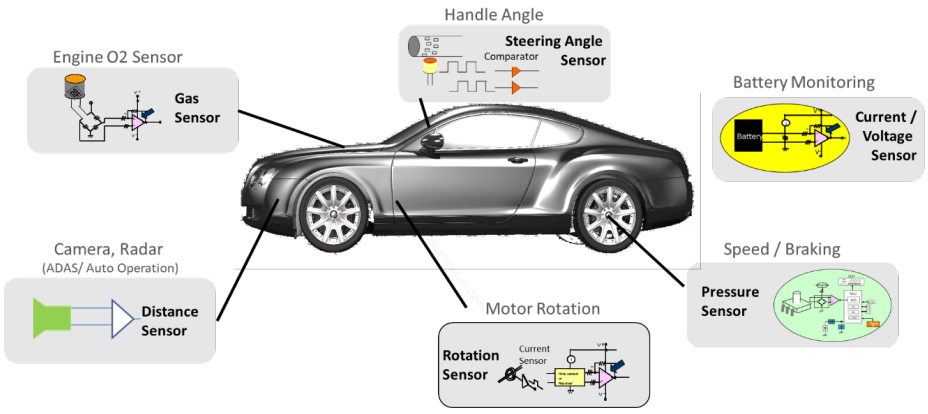


Figure 1: *Op-Amp inside Sensor Modules inside Automotive*

UPC842AMP

The UPC842AMP is a high-speed dual operational amplifier that is suited for automotive sensor applications due to its ability to achieve high-speed response time and high stability. This is because of its internal circuit using a high-speed PNP transistor that improves slew-rate, gain bandwidth product, and stabilization of heavy load capacitance with no crossover distortion.

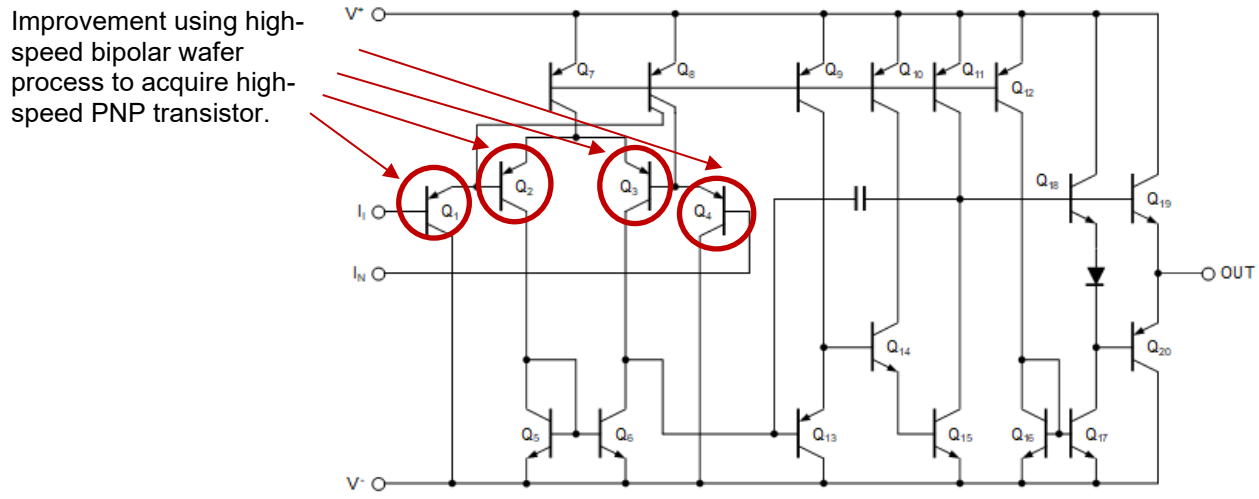


Figure 2: *UPC842AMP Op-Amp Internal Circuit*

Higher Slew Rate

The UPC842AMP has a higher slew rate compared to the currently available Renesas op-amp line-up. A higher slew rate means a higher speed op-amp, or reproduction of the output signal without significant delay in response to the input. In Figure 3 below, we can see that the UPC842AMP has a 7V/u where others have less. In Figure 4, a comparison chart has been made to compare the UPC842AMP to other makers in the market.

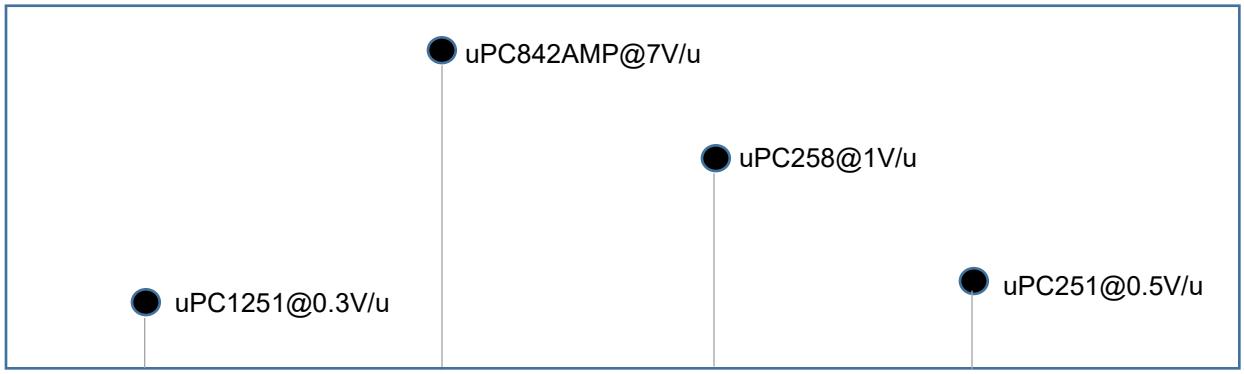


Figure 3: *Renesas Bipolar Op-Amp Slew Rate*

The below (Figure 4) shows a good balance, or minimal difference, between the rise time and fall time in the UPC842AMP compared to competitors.

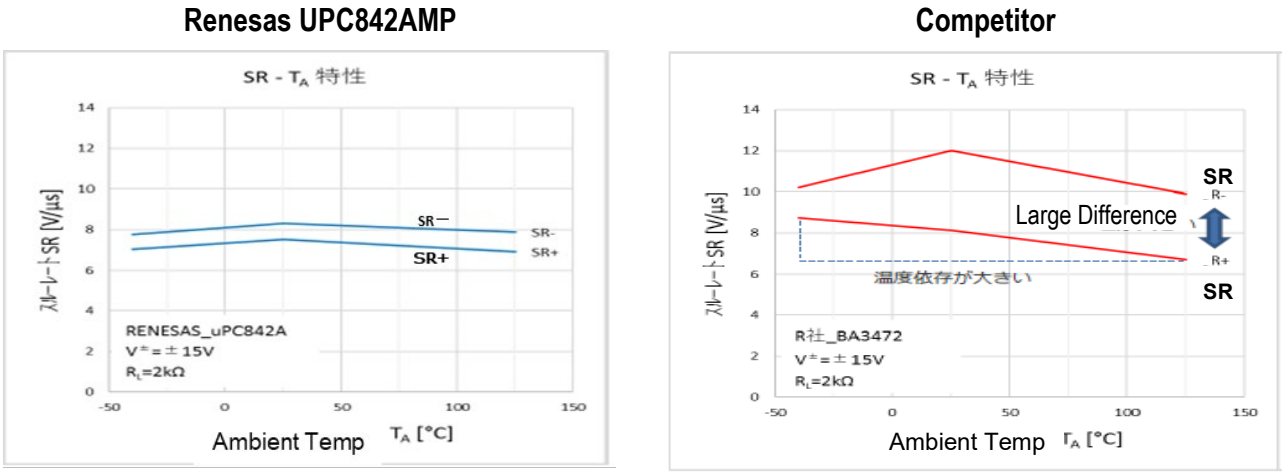


Figure 4: *Comparison Graph of UPC842AMP and Competitor for Slew Rate vs. Ambient Temp*

The UPC842AMP has a cleaner, more accurate output signal with minimal overshoot / undershoot under a prefix test condition. This is important especially when we may have to work with large capacitive loads and the op-amp needs to be as stable as possible so that it can modulate the loop gain into unstable regions.

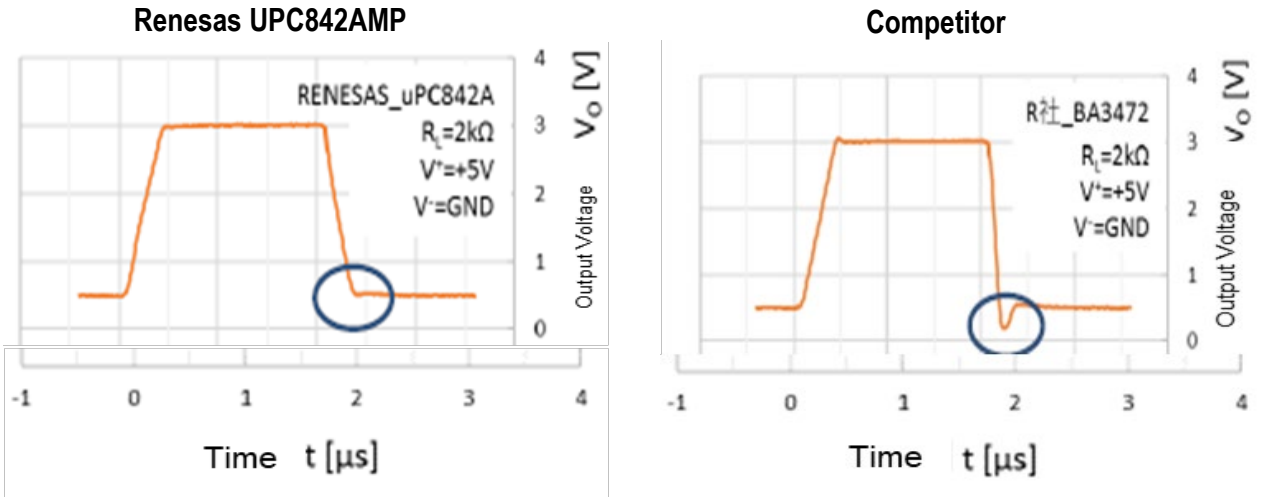


Figure 5: *Comparison Graph of UPC842AMP & Competitor for Slew Rate*

Smaller Footprint

The UPC842AMP has the smallest package size and footprint compared to the existing Renesas Op-Amp line-up available. The MSOP package, with a diameter of 2.8mm x 2.0mm x 1.03mm, is considered to be 34% smaller than the conventional SOP8 package that is widely available in the market.

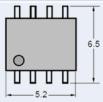
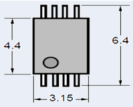
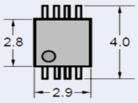
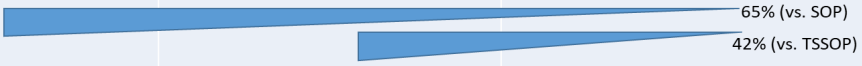
Package	SOP8	TSSOP8	MSOP8
Product	(Mass Production) UPC1251G2 UPC842G2 UPC4570G2, Others	(Mass Production) UPC1251GR UPC842GR UPC4570GR Others	UPC842AMP UPC4570MP (under planning) UPC1251MP
Package	 Package Thickness 1.59 ±0.21	 Package Thickness 1.2 (max)	 Package Thickness 1.03 (max)
Mounting Area	100%	60%	34%
Mounting Area Reduction	 SOP	TSSOP	MSOP

Figure 6: *Package Comparison Table*

Benefits of Small Package in ECU

With the MSOP package, automotive makers can design their ECU or other sensor portion in a smaller, more compact way. Moreover, improvement in getting cleaner signal processing is achievable by having placement of op-amp closer between the sensor and signal processing IC. This configuration will not be achievable if the op-amp package is larger, and due to ECU inside an automobile, it is susceptible to noise, thus having op-amp and signal processing near the ECU (including an MCU) will induce lower noise. Figure 7 below illustrates the importance of the operational amplifier placement.

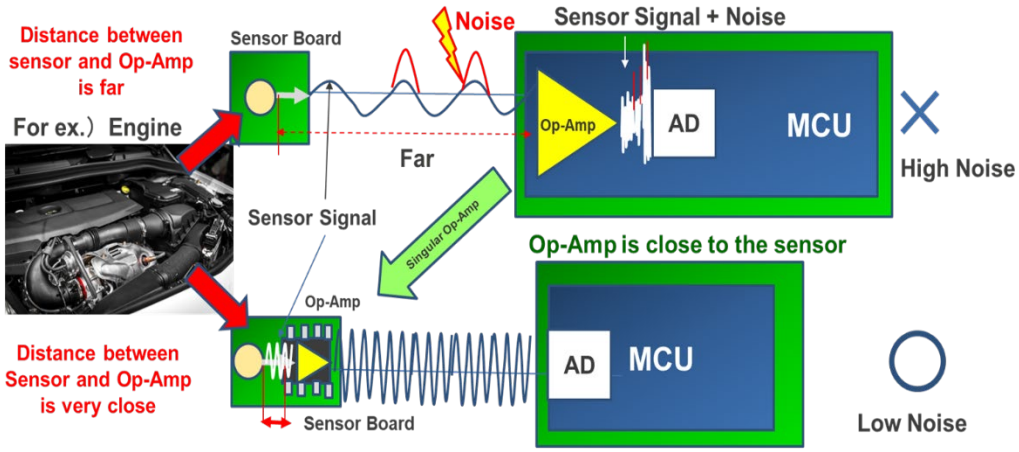


Figure 7: *Op-Amp Placement onto Automotive ECU*

Conclusion

We have discussed the design, function, and implementation of the new Renesas Operational Amplifier and explained its technical advantages. Apart from benefits discussed in this white paper, this Operational Amplifier has several other key benefits:

- Compliance with the automotive reliability standard, AEC-Q100
- High Slew Rate of 7V/us
- Wider Gain Bandwidth Product (GBP) of 3.5MHz
- Small package, MSOP (2.8 x 2.9 x 1.0mm)
- Power Supply Operating Range: 3V – 32V

Learn More

Renesas Operational Amplifier and Comparator Video ›