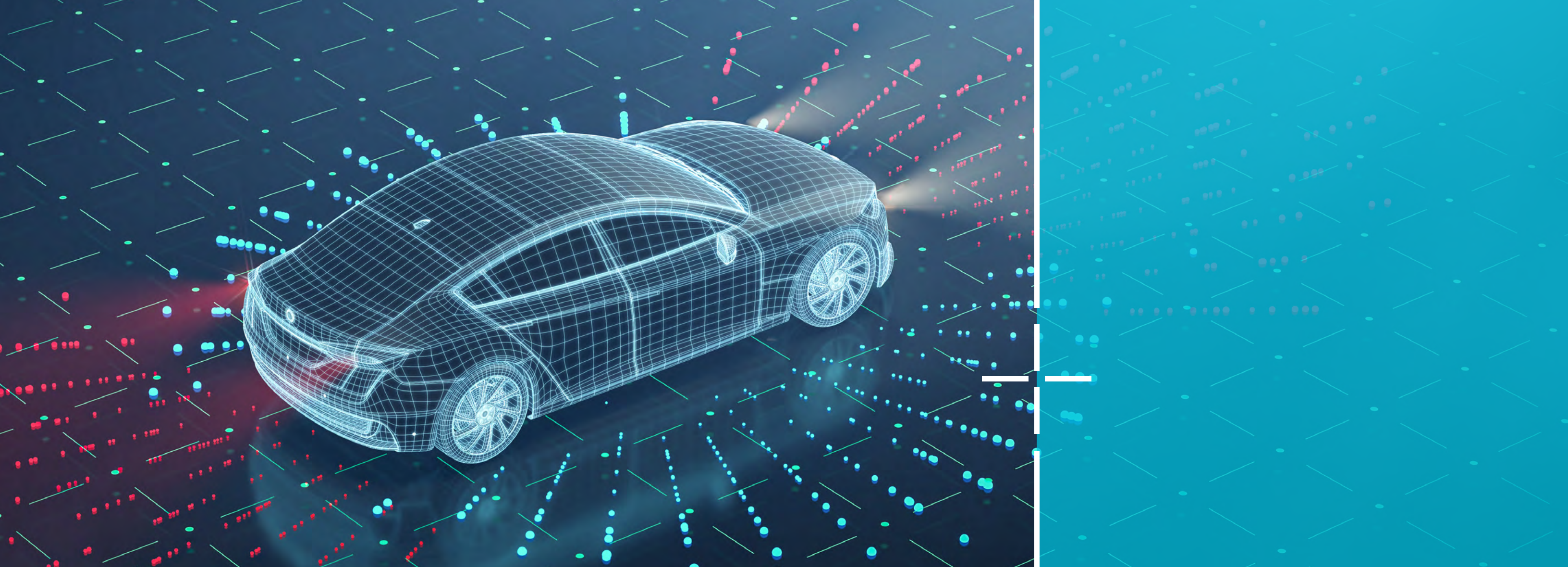
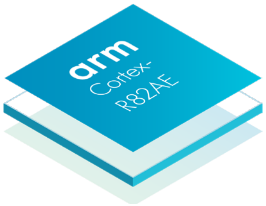


PRODUCT BRIEF

Arm Cortex-R82AE



KEY FEATURES AND BENEFITS

- **Enables the Flexible Deployment of Software Stacks**
  Cortex-R82AE lets you run both deterministic real-time software stacks and rich software stacks, all from a single processor without loss of real time.
- **Provides Scalability Across Automotive Computing Systems and Applications**
  Cortex-R82AE can be integrated across advanced heterogeneous automotive system-on-chip (SoC) for applications such as ADAS, digital cockpit, and all zonal controllers.

INTRODUCTION

The transformation of the automotive industry and the emergence of software-defined vehicles (SDVs) are driving ever-increasing compute complexity and demands on silicon processing performance. As a result, the vehicle architecture is changing with more centralization and increased use of high-performance processors.

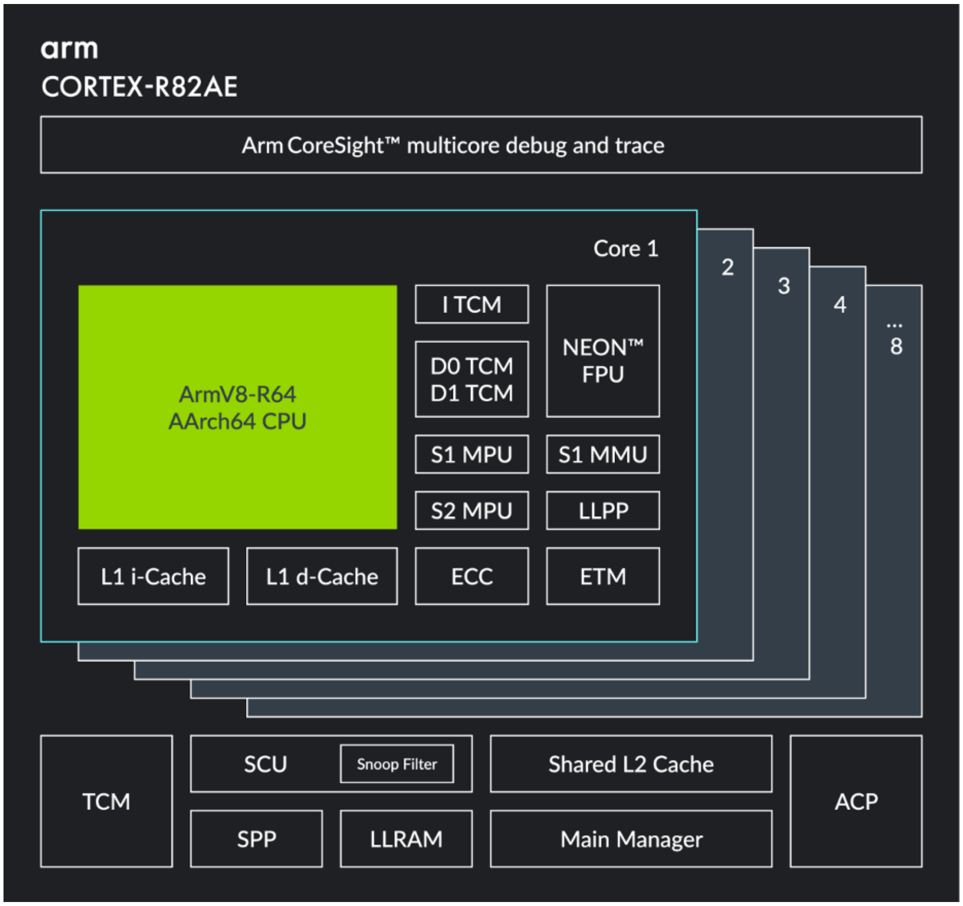
Alongside supporting an elevated class of performance, automotive computing systems must also meet the highest levels of safety. Increasingly, functionality is being added to high-performance controllers located in zones around the vehicle, integrating a diverse range of functions for both signal-based and serviced-based operations. Any safety-related vehicle operation must be checked and the computing systems must respond in a known, strongly bounded time. This is typically achieved using real-time safety islands, which have been critical to safety operations and are increasing across many systems. The new Arm Cortex-R82AE is ideally suited to meet

- **Offers Significant Single-Thread Performance Uplift**
  Cortex-R82AE delivers more than a 50 percent increase in performance for single-thread workloads that are commonly used in AI-based automotive applications.
- **Delivers Advanced Functional Safety and Security Features**
  Cortex-R82AE delivers a variety of advanced functional safety and security features that can be configured for specific partner needs and requirements.

USE CASES

- Primary Processor in High-Performance, Real-Time Safety-Enabled Zonal Controllers
- Advanced Safety Controllers

these high-performance and advanced safety function requirements by delivering a step change in real-time computing capabilities.



HIGHLIGHTS

Arm partners have embraced the benefits of Arm Cortex-R CPUs, with many examples of the Arm Cortex-R52 and Cortex-R52+ being featured across automotive use cases. The Cortex-R82AE processor now delivers advanced features for key automotive use cases, improved functional safety, and more performance than ever before.

Enables the Flexible Deployment of Software Stacks

The requirements of every zonal controller are different, with each demanding a diverse mix of processor performance and software. This may be the result of a zonal controller's position in the vehicle, or its development over time as over-the-air (OTA) updates add new capabilities throughout the lifetime of vehicles. A single hardware design using Cortex-R82AE can be deployed to address these diverse needs, without requiring fixed partitioning between the type of processing used. This helps to future-proof automotive computing solutions and provides a high degree of flexibility as zonal controllers in vehicles continue to evolve.

Cortex-R82AE enables the flexible deployment of different software stacks. It can support both real-time software stacks, such as those deployed using Classic AUTOSAR in many established control applications, as well as the ability to run rich software stacks, such as Linux, for service-based functions. This software flexibility helps users readily change the software partitioning used in an automotive computing system as zonal controller requirements evolve.

Scalability Across Automotive Computing Systems and Applications

Cortex-R82AE can be integrated in advanced homogeneous SoCs used in some zonal controllers. It can also be deployed in heterogeneous automotive systems where some higher performance zonal controllers are integrated, as well as broader deployment in applications like ADAS, autonomous drive controllers, and digital cockpit.

When combined in a heterogenous automotive SoC with a mix of different types of compute, Cortex-R82AE integrates seamlessly with high-performance applications processors. This is due to its virtual memory system architecture (VMSA) and large 48-bit address space.

Cortex-R82AE can be configured and optimized across a variety of automotive computing systems. The 64-bit instruction set of the processor means that the system can address up to 256 TB. This simplifies the integration of the processor into large heterogenous computing systems, particularly when mixed with application processors in autonomous and central vehicle servers.

Meanwhile, the increasing need for zonal controllers makes Cortex-R82AE an ideal solution. Zonal controllers must be able to support a mix of different functions combined, ranging from conventional signal-based control, which is often the realm of AUTOSAR classic software stacks, to service-based software, which often use POSIX-compliant operating systems. The Cortex-R82AE combination of support for both a physical memory system architecture (PMSA) and its VMSA means software stacks can be supported on a single processor, while providing the ability to combine software through the processor's real-time virtualization support.

Improved Single-Thread Performance

Compared to Cortex-R52+, one 64-bit Cortex-R82AE core can deliver more than 50 percent higher performance for single-thread workloads at the same execution speed. This is achieved by its high performance in order pipeline. When combined with the fact that now double the number of Cortex-R82AE cores can be integrated in a single cluster – eight compared with four in Cortex-R52+ – there is an even greater performance increase. These performance improvements are also enabled through the FPU and SIMD extensions, which have been updated to offer higher performance for AI and ML-based workloads through the availability of dot product operations and more efficient half-precision floating point support.

Advanced Functional Safety and Security Features

Cortex-R82AE introduces further functional safety features to meet the stringent safety goals required for many automotive computing systems. The processor builds on top of previous Cortex-R cores with features such as split/lock that enable the construction of the system-on-chip (SoC) with additional flexibility. For example, a single silicon design can be configured to either operate with pairs of Cortex-R cores that check each other's functionality in dual-core lockstep (DCLS) mode, or by configuration in the field, where they can be split to provide higher performance without the increased fault coverage.

For split-mode use, Cortex-R82AE introduces new features to achieve safety levels up to ASIL B at a lower power and area cost than full duplication. Hybrid mode enables sections of the processor to remain in lockstep to improve availability and protect areas of the design that are difficult to check without intrusive testing mechanisms. In hybrid mode, the bulk of the processor remains split and is free to deliver increased performance with individual pipelines. Cortex-R82AE also enables protection against memory errors and protects flops through the introduction of transient fault protection (TFP).

The processor also has an Arm Software Test Library (STL) available to enable core self-testing. These routines can be run quickly and flexibly in small bursts to check operations at both start-up and runtime. Used in conjunction with features, such as TFP and hybrid mode, they enable a pathway to build an ASIL-B-level processor, with lower area and power overhead than DCLS.

From a security perspective, Cortex-R82AE is built on the Armv8-R64 architecture that introduces new security features. This includes Pointer Authentication that helps to guard against software attempting to exploit return-orientated programming attack vectors. Cortex-R82AE also introduces interface protection, deploying the standard RAS safety extension that assists with processor integration into heterogenous computing systems.