Technical Article

How MCUs can unlock the full potential of electrification designs

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Not too long ago, widespread adoption of electric vehicles (EVs) was nothing but science fiction. Once thought too expensive or impractical, we are now in the midst of an EV revolution driven by OEMs' desire to achieve zero emissions and explore alternative energy sources. Many car manufacturers have gone all-in by pledging all-EV lineups in the next 10 to 15 years.

Despite this momentum, we stand at an inflection point. EVs have made significant steps toward mainstream acceptance as drivers are looking for lower energy cost per mile and a fun driving experience that EVs can deliver. However, EVs are currently more expensive compared to internal combustion engine vehicles. There are also some concerns from drivers around range anxiety given the existing lack of charging stations, low driving range per charge, and the long charging time to get a full battery.

At the heart of every EV are power electronics systems: a traction inverter, onboard charger and high-voltage DC/DC converter, as shown in Figure 1. The performance of these systems will help define the acceleration and success of EV adoption in the coming years, as they directly impact an EV's driving performance, cost, driving range, and charge time. The demand for more performance from these systems directly translates to demand for more microcontroller (MCU) performance, in terms of both real-time control and advanced computing.

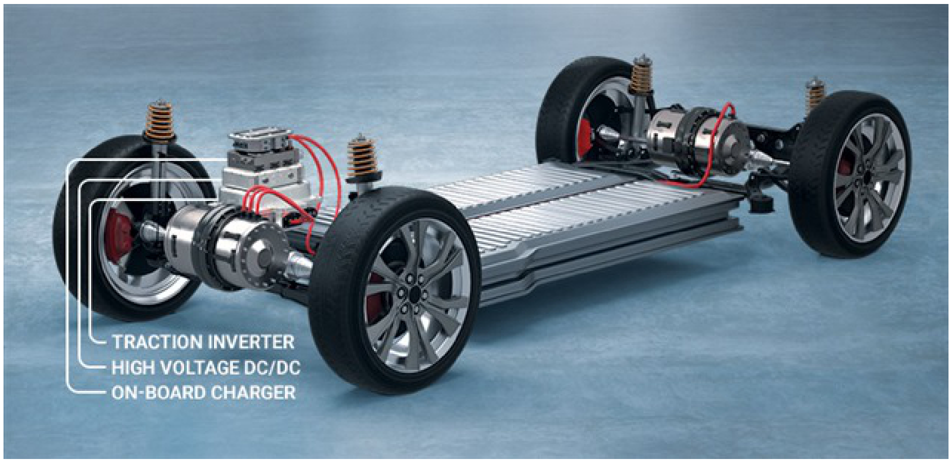

Figure 1. The EV powertrain, including: traction inverter, high-voltage DC/DC, and onboard charger

Our new high-performance Sitara™ AM263 MCUs are the latest addition to the Sitara MCU family, and can help customers make progress in advancing the processing technology behind EVs. Sitara AM263 MCUs are the first devices in the Sitara MCU portfolio that pair the real-time control subsystem originated in C2000™ MCUs with the Sitara multicore Arm® architecture to meet the dynamic performance demands needed for motor and digital power control applications.

By combining real-time control and more than 3,000 Dhrystone million-instructions-per-second (DMIPS) computing performance, the AM263 MCU family can help reduce size and weight of the motor and mechanical enclosures as well as system cost, increasing driving range and helping to make EVs more affordable. The AM263 MCU family naturally leverages and extends the benefits of the C2000 real-time MCUs to offer even more options for EV powertrain applications.

For example:

- In traction inverters, AM263 MCUs enable higher motor speeds (>30,000 rpm), which can reduce motor size by as much as 36% and increase driving range by 15%.
- The MCU's ability to run at higher switching frequencies (>1 MHz) unlocks the potential for the use of wide-bandgap technologies such as silicon carbide (SiC) and gallium nitride (GaN), increasing power density and efficiency and thereby increasing driving range.
- More cores and peripherals enable the integration of multiple functions and reduce both the number of field-effect transistors in a system and mechanical enclosures, significantly reducing cost and weight of enclosures and magnetics.
- AM263 family incorporates functional safety features that enable up to Automotive Safety Integrity Level (ASIL) D, E-Safety Vehicle Intrusion Protected Applications (EVITA) hardware security module full version, Automotive Open System Architecture (AUTOSAR) support, and communication peripherals to help reduce system bill of materials with a single chip.

With EVs and renewable energy comes the need for an extensive charging infrastructure and energy storage systems, as pictured in Figure 2. To be as common and as quick as a gas station, these systems need to be more efficient and higher power. The fundamental concept of these systems is power conversion, which enables grid-to-vehicle and vehicle-to-grid energy transfer in charging stations. And in energy storage systems, power conversion enables the storing of energy in batteries when demand is low and delivers it to the grid when demand is high, or when the renewable energy source is not generating. The real-time control subsystem integrated in the AM263 family delivers the necessary precision to lead the power conversion industry into the future. For example, with the AM263 MCU family you can now achieve:

- Faster charging time. Achieving higher levels of switching frequency, higher inverter efficiency (99%), and less power loss, AM263x helps to deliver faster and higher power conversion.
- Improved output power quality for electric grid compatibility. Advanced analog control peripherals enables higher precision for lower latency, lower total harmonic distortion (THD) and higher output power quality in solar inverters.

- Reduced system size and cost. Multiple Arm® cores enables complex control topologies and reduces the system size and BOM cost by integrating functions.

Figure 2. Electrification extends beyond EVs to charging stations and renewable energy storage

The world around us is changing. Environmental and regulatory pressures for zero-emission vehicles and renewable energy sources are accelerating EV production, but widespread adoption will require increased affordability, efficiency and performance. Sitara AM263 MCUs, including the AM2634-Q1 and AM2634 devices, help deliver on the demands of these next-generation architectures. Get started with the AM263 family today and explore our application note, "AM263 for Traction Inverters", and our easy-to-use MCU+ software development kit (SDK), or create and implement examples in just minutes with our TMDSCNC263 evaluation module (EVM) and MCU+ Academy.

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