Wireless Battery Management System Solution Improves Range, Reliability And Safety For EVs

Texas Instruments' wireless battery management system (BMS) solution for EVs is being touted as the industry's highest-performing solution for wireless BMS, featuring the first independently assessed functional safety concept. Through an advanced wireless protocol with the industry's best network availability, according to the vendor, TI's wireless BMS solution demonstrates how vehicle designers can remove heavy, expensive, maintenance-prone cabling and improve the reliability and efficiency of EVs worldwide. Fig.1 illustrates the problems posed by wired EV battery management systems.

TI's solution for wireless BMS empowers automakers to reduce the complexity of their designs, improve reliability and reduce vehicle weight to extend driving range. With the flexibility to scale designs across production models, automakers can advance to production faster with TI's wireless BMS offering, which including the SimpleLink 2.4-GHz CC2662R-Q1 wireless microcontroller (MCU) evaluation module, software and functional safety enablers such as a functional safety manual; failure mode and effects analysis (FMEA); diagnostic analysis (FMEDA); TÜV SÜD concept report; and the recently announced BQ79616-Q1 battery monitor and balancer (Fig. 2).

"The implementation of wireless battery management systems will be a growing trend in the EV marketplace because these advancements provide greater flexibility of design while also lowering the complexity and cost relative to traditional systems," said Asif Anwar, director of the powertrain, body, chassis and safety service at Strategy Analytics. "By demonstrating a solution that combines these advantages with ASIL D compliance, the TI solution sets a benchmark for the industry to follow."

To speed automakers' development time, TI requested that TÜV SÜD, a functional safety authority, independently evaluate the quantitative and qualitative error-detection performance as well as the feasibility for automakers to achieve Automotive Safety Integrity Level (ASIL) D, the highest level of ISO 26262 certification, using TI's wireless BMS functional safety concept.

Using a new wireless protocol, developed specifically for the wireless BMS use case, TI's wireless BMS functional safety concept addresses communication error detection and security. The proprietary protocol via the CC2662R-Q1 wireless MCU enables a robust and scalable data exchange between a host system processor and the BQ79616-Q1 battery monitor and balancer.

Rivaling wired connections, TI's wireless protocol for BMS via the CC2662R-Q1 wireless MCU is said to offer the industry's highest network availability of greater than 99.999% and a network restart of 300-ms maximum availability. With this wireless MCU, dedicated time slots that provide high throughput and low latency protect data from loss or corruption while enabling multiple battery cells to send voltage and temperature data to the main MCU with ±2-mV accuracy and a network packet error rate of less than 10^{-7} (Fig. 3).

Automakers can mitigate potential threats with security enablers from TI such as key exchange and refreshment; unique device authentication; debug security; software IP protection with a JTAG lock; Advanced Encryption Standard (AES) 128-bit cryptographic acceleration and message integrity checks.

Anticipating automakers' long-term design needs, TI's wireless BMS innovation is also scalable. The deterministic protocol provides the highest throughput in the market, according to the vendor, enabling automakers to create a battery module using a single wireless system-on-chip connected with multiple BQ79616-Q1 battery monitors for different configurations such as 32-, 48- and 60-cell systems. The system is designed to support up to 100 nodes with what's described as the industry's lowest latency of less than 2 ms per node and time-synchronized measurements across every node.

The CC2662R-Q1 wireless MCU isolates individual cell monitoring units, eliminating the need for and cost of daisy-chain isolation components. The BQ79616-Q1 battery monitor and balancer offers different channel options in the same package type, providing pin-to-pin compatibility and supporting reuse of the established software and hardware across any platform.

Automakers can jump-start their designs by downloading the SimpleLink wireless BMS software development kit (SDK), available at no cost and by purchasing the SimpleLink wireless BMS evaluation module (CC2662RQ1-EVM-WBMS), which is available on TI.com for $999. The CC2662R-Q1 wireless MCU is priced at $2.79 in 1,000-

unit quantities. The 16-channel BQ79616-Q1 comes in a 10-mm-by-10-mm, 64-pin HTQFP, and is priced at $6.90 in 1,000-unit quantities. All products featured in the wireless BMS solution are immediately available for purchase on TI.com. For more information on the wireless MCU, see the CC2662R-Q1 page. For more on the battery monitor and balancer, see the BQ79616-Q1 page. For further background on this announcement, watch the video "Revolutionize EV battery management with our wireless BMS solution".

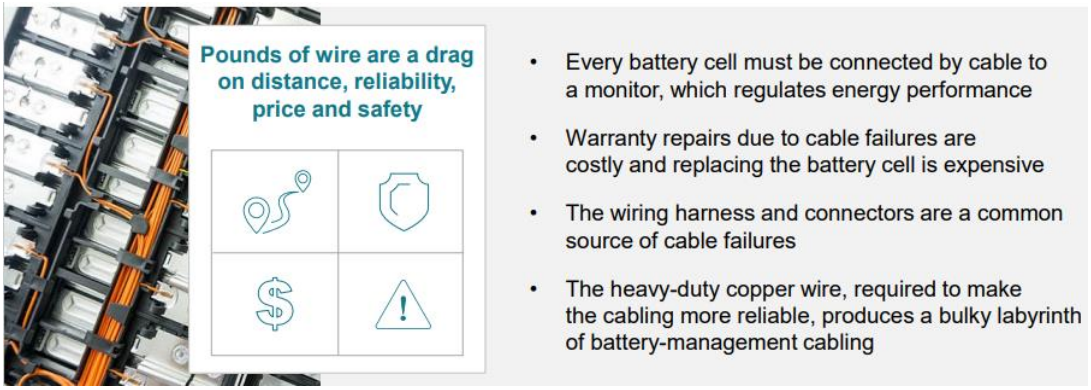

Fig. 1. A wireless EV battery management system (BMS) addresses several challenges posed by wired BMSs in EVs including the heavy cable weight and associated space requirements, and the warranty repairs due to cable failures.

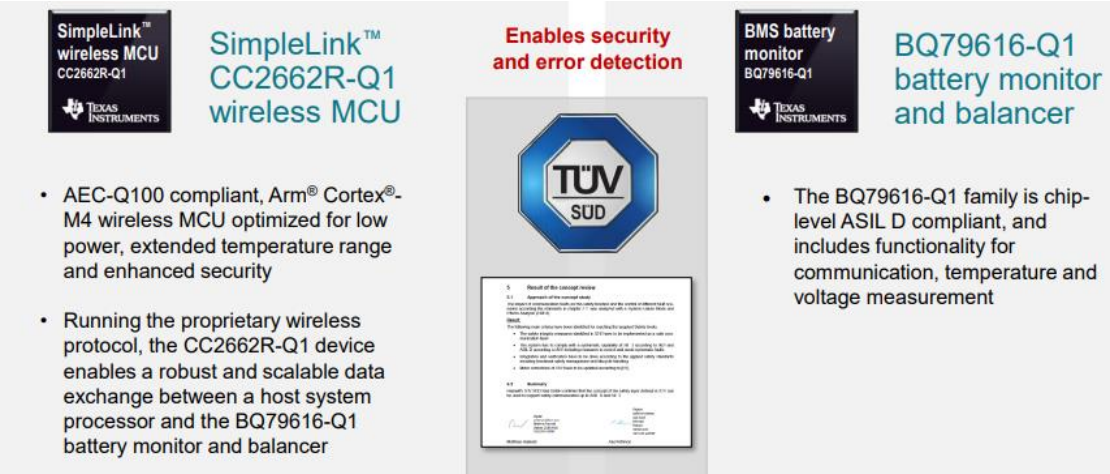

Fig. 2. TI's solution for wireless BMS empowers automakers to reduce the complexity of their designs, improve reliability and reduce vehicle weight to extend driving range. TI's wireless BMS offering includes the SimpleLink 2.4-GHz CC2662R-Q1 wireless MCU eval module, software and functional safety enablers such as a functional safety manual; failure mode and effects analysis; diagnostic analysis; TÜV SÜD concept report; and BQ79616-Q1 battery monitor and balancer.

Fig. 3. TI's wireless BMS securely supports the industry's best network availability, according to the vendor.