TECHNICAL ISO/TR

First edition
2023-06

Road vehicles — Functional safety — Application to generic rechargeable energy storage systems for new energy vehicle

Véhicules routiers — Sécurité fonctionnelle — Application des systèmes génériques rechargeables de stockage d'énergie aux véhicules utilisant les énergies nouvelles

Reference number
ISO/TR 9968:2023(E)

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Published in Switzerland

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Foreword

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This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 32, *Electrical and electronic components and general system aspects*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The rechargeable energy storage systems (RESS) (e.g. lithium-ion battery systems) used for new energy vehicles can introduce specific hazards like thermal runaway, toxic chemical release, high voltage electric shock, etc.

To prevent and mitigate the risk of RESS related hazards, E/E related technology, such as battery management systems (BMS), are integrated into the RESS. However, based on accident investigations and statistics, a large proportion of RESS safety-related incidents are caused by faults within the E/E systems (e.g. BMS), elements of other technologies (e.g. battery cells) or both[15]. Due to the possibility of the mechanical and electrochemical characteristics of the battery changing constantly over the lifecycle [e.g. state of health (SOH), state of health energy (SOHE), direct current resistance (DCR) for electrochemistry, and mechanical stress, air-dust tightness, resistance to chemicals for mechanical parts] the correlated safety threshold parameters of the battery can also change accordingly which can lead to reduced or even incorrect monitoring and control of the BMS.

Effective safety design and management of RESS relies on system capability to adaptively adjust the logic and control according to the alteration of mechanical and electrochemical related characteristics of the battery. The ISO 26262 series is focused on the malfunctioning behaviour of E/E systems. An item (as well as external measures) can include systems or elements of other technologies. Malfunctioning behaviour can be caused by failures of systems or elements of other technologies. However, the ISO 26262 series includes limited guidance concerning such failures, for example, sudden failures or wear out of other technologies.

The purpose of this document is to present a case study of functional safety for RESS considering E/E systems (e.g. BMS) and mechanical, electrical and electrochemical factors for elements of other technologies (e.g. battery cells) according to the methodology of the ISO 26262 series, and to show examples of functional safety development for E/E systems (e.g. BMS) and systems of other technologies as a reference.

Based on the ISO 26262:2018 series, the case study in this document provides an additional methodology to cover the strong interaction between E/E systems (e.g. BMS) and systems of other technologies (e.g. battery cells) by considering E/E, mechanical and electrochemical related factors. This document follows the V model framework defined in the ISO 26262 series and provides corresponding functional safety strategies, and verification and validation methods for the development of a functionally safe RESS.

All the technical information and the associated data in this document are combined with the state-of-the-art technologies of current automotive battery industry, which will be updated with the development of battery cell technology and other related technology.