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Electrically propelled road vehicles — Specification of voltage sub-classes for voltage class B

Véhicules routiers à propulsion électrique — Spécification de sous-classes de tension pour les tensions de classe B

PROOF/ÉPREUVE

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Foreword

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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 37, *Electrically propelled vehicles*.

Introduction

Electric systems operating at voltage class B are efficient systems for electrically propelled road vehicles. The requirements for voltage class B electric circuits that are used for electric power transfer for the propulsion of electric road vehicles are significantly different to those of voltage class A electric circuits used for powernets at, for example, 12 V d.c. or 24 V d.c.

This PAS provides definition of voltage sub-classes for rechargeable energy storage system (RESS) and electric propulsion system and lists up specified values based on maximum working voltage. Voltage sub-classes listed in this PAS are used for voltage class B systems of all kinds of current or future electrically propelled road vehicles. It enables vehicles manufacturers and automotive supply industry to evaluate the characteristics of a component according to the specified sub-class.

The voltage sub-class itself and the component characteristics have large cost impact on the component design and the overall design of the electric system. A high variety of different voltage sub-class and operating conditions hinders the use of an existing component in different vehicle models.

Today, a huge variety of different RESS and electric propulsion system maximum working voltages are used for electrically propelled road vehicles on the market. Because some systems use voltage boost converters, maximum working voltage of electric propulsion system can be different from that of RESS. This variety of maximum working voltages often results from different numbers of cells in the design of the electrical energy source, e.g. battery stack or variety of power requirement by each vehicle. As a consequence, many system or component designs of a voltage class B electric circuit are currently related to one specific working voltage. When a maximum working voltage is selected for the design, often only one supplier for a component is available. Hence, a change to another component supplier or a change of the dedicated maximum working voltage is not possible, when the system design is finished. It is necessary to reduce the variety of maximum working voltages in order to

— lower the component and system costs by limiting the variety of maximum working voltages,

— decouple the system or component designs of a voltage class B electric circuit from the design of the electric energy source,

— enable an exchange of components from different suppliers during and after the system development and to enable competition and access to the worldwide market for component suppliers, and

— support the system design by specifying basic voltage sub-classes for automotive propulsion systems within voltage class B.

This PAS lists only those RESS and electric propulsion system voltage sub-classes which are used or will be used in current or planned vehicle models and for which electronic parts, e.g. semiconductor switches, are currently available without any restrictions on the market.

The range of voltage class B is too wide to be used for a component design referring to voltage. Therefore, this PAS divides voltage class B in a set of voltages sub-classes, which enable a component design referring to voltage for each voltage sub-class.

This specification is not intended to restrict the development of component performance or technology. It does not exclude the use of other maximum operating voltages for an individual system design.

Electrically propelled road vehicles — Specification of voltage sub-classes for voltage class B

1 Scope

This PAS provides specification of voltage sub-classes for electric propulsion systems and conductively connected auxiliary electric systems of electrically propelled road vehicles.

The voltage sub-classes are related to d.c. electric circuits.

It applies only to electric circuits and components with maximum working voltages according to voltage class B.

This PAS provides specifications of characteristics which are relevant for design and operation of components and systems for the standardized voltage sub-classes.

It enables vehicle manufacturers and supply industry to evaluate the characteristics of components or systems for their specific vehicle applications.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
component operating status
describes the general functional behaviour of components which depend directly on the voltage in voltage class B electric circuits

2.2
customer
party that is interested in using voltage class B component or system

2.3
DUT
device under test

2.4
electric circuit
entire set of interconnected live parts through which electrical current is designed to flow under normal operating conditions

2.5
electric propulsion system maximum working voltage
highest value of d.c. voltage that can occur in an electric propulsion system under any normal operating conditions according to the customer's specifications, disregarding transients

2.6
maximum working voltage
highest value of a.c. voltage (rms) or of d.c. voltage that can occur in an electric system under any normal operating condition according to the customer's specifications, disregarding transients

Note 1 to entry: In this definition taken from ISO 6469-3, transients include ripple.

2.7
rechargeable energy storage system
RESS
system that stores energy for delivery of electric power and which is rechargeable

EXAMPLE Batteries, capacitors, etc.

2.8
ripple
set of unwanted periodic deviations with respect to the average value of the measured or supplied quantity, occurring at frequencies which can be related to that of components within a system

2.9
supplier
party that provides voltage class B component or system

2.10
transient
pertaining to or designating a phenomenon or a quantity which varies between two consecutive steady states during a time interval short compared with the time-scale of interest

2.11
voltage class B
classification of an electric component or circuit with a maximum working voltage between 30 V a.c. (rms) and 1 000 V a.c. (rms) or between 60 V d.c. and 1 500 V d.c

Note 1 to entry: Values for voltage class B are taken from ISO 6469-3.

2.12
upper voltage limit
maximum voltage of a voltage class B sub-class

Note 1 to entry: Maximum working voltages within a voltage sub-class are less than or equal to the voltage limit.

2.13
voltage range
general term covering voltage sub-class, working voltages and deviations from working voltages

2.14
voltage sub-class
classification of an electric component or circuit with a d.c. voltage within the voltage class B

2.15
working voltage
a.c. voltage (rms) or d.c. voltage that can occur in an electric system under normal operating conditions according to the customer's specifications, disregarding transients

3 Voltage sub-classes

The specifications and requirements on voltage sub-classes shall apply to electric circuits, systems and components at voltage class B.

The specifications and descriptions of voltages for a component shall apply to the voltage at its terminals to the voltage class B electric circuit, if not otherwise stated in this International Standard.

The voltage sub-classes shown in Table 1 are based on the specification of an upper voltage limit for each voltage sub-class.

Table 1 — Voltage sub-classes

Voltage sub-class	Upper voltage limit V d.c.
B_220	U ≤ 220
B_420	U ≤ 420
B_470	U ≤ 470[a]
B_750	U ≤ 750[b]
B_850	U ≤ 850
B_1250	U ≤ 1 250[c]

[a] B_470 is considering 700 V breakdown voltage for IGBT and dedicated module technology (Table A.2).

[b] B_750 is related to a voltage classification of 750 V d.c. given by regulation in Japan.

[c] B_1250 is considering the limit of 1 000 V a.c. for voltage class B.

4 Characteristics of voltage sub-classes

4.1 General

The specifications and characteristics for voltage sub-classes include the following subjects:

— component operating status;

— voltage operating ranges;

— under- and overvoltages;

— voltage transients and ripple for components.

The voltage ranges and operating status shall apply to all components for the selected voltage sub-class. The voltage sub-class depends on a vehicle project and shall be selected by an agreement between customer and supplier.

The requirements in accordance with Table 1 shall apply to a RESS when it is disconnected from the voltage class B electric circuit.

Different requirements may be specified by the customer for a RESS when it is connected to the voltage class B electric circuit because the voltage of RESS is limited to the maximum working voltage of the vehicle project and given by the number of battery cells.

For each voltage sub-class, the corresponding working voltages, component operating status, overvoltage and under-voltage are described as follows.

4.2 Component operating status

The operating status is introduced to describe the general operating behaviour of components that depends directly on the voltage at the terminals of a component of the voltage class B electric circuit and is mainly focused on performance and electrical power.

In every operating status, the components shall fulfil the following requirements:

— it shall be ready to operate;

— it shall not enter any undefined states;

— it shall not cause any failure in other components.

The different operating statuses are described in Table 2.