TR 25 : 2016+A1:2020
(ICS 43.120)

TECHNICAL REFERENCE

Electric vehicle charging system

Incorporating Amendment No. 1

Singapore Standards Council

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(ICS 43.120)

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Published by Enterprise Singapore

ISBN 978-981-49-2578-5

First published, 2010
First revision, 2016
Second revision, 2020

NOTE

1. *Singapore Standards (SSs) and Technical References (TRs) are reviewed periodically to keep abreast of technical changes, technological developments and industry practices. The changes are documented through the issue of either amendments or revisions. Where SSs are deemed to be stable, i.e. no foreseeable changes in them, they will be classified as "Mature Standards". Mature Standards will not be subject to further review, unless there are requests to review such standards.*

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Foreword

This Technical Reference (TR) was prepared by the Technical Committee on Electric Vehicles under the purview of the Electrical and Electronic Standards Committee (EESC). It was endorsed by the EESC on 21 July 2016.

This TR was revised to further align with the international requirements IEC 61851 series and IEC 62196 series of standards. Section One retains most of the requirements of the 2010 edition of the TR and includes requirements for a.c. charging using Type 2 vehicle coupler and accessories. The control pilot function requirement using PWM signal was also updated. New requirements covering d.c. charging stations and accessories are covered in Section Two. Requirements for "Energy transfer from vehicle to grid" are not considered in this revision.

This TR is a provisional standard made available for application over a period of two years. The aim is to use the experience gained to update the TR so that it can be adopted as a Singapore Standard. Users of the TR are invited to provide feedback on its technical content, clarity and ease of use. Feedback can be submitted using the form provided in the TR. At the end of the two years, the TR will be reviewed, taking into account any feedback or other considerations, to further its development into a Singapore Standard if found suitable.

In preparing this TR, references were made to the following standards:

1. Singapore Standard SS CP 5 : 1998 Code of practice for electrical installations

2. IEC 61851 Electric vehicle conductive charging system

   - Part 1:2001 General requirements
   - Part 1:2010 General requirements
   - Part 1 FDIS:2016 General requirements (Edition 3.0)
   - Part 21-2 CD:2014 EMC requirements for OFF board electric vehicle charging systems (Edition 1.0)
   - Part 22:2001 AC electric vehicle charging station
   - Part 23:2014 DC electric vehicle charging station

3. IEC 62196 Plugs, socket-outlets, vehicle connector and vehicle inlets – Conductive charging of electric vehicles

   – Part 1:2014 General requirements
   – Part 2:2016 Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
   – Part 3:2014 Dimensional compatibility and interchangeability requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers

Acknowledgement is made to the International Electrotechnical Commission (IEC) for permission to reproduce information from the following International Standards:

IEC 62196-1:2014

- Clauses 14 and 15
- Clauses 22 and 23
- Figures 8 to 10

IEC 62196-2:2011

- Table 103 (Sheet 2-I, Type 1, Sheet 2-IIe, 2IIf and 2IIh Type 2)

IEC 62196-3:2014

- Standard sheets (Configuration AA, Standard Sheet 3-Ia to 3-If and Configuration FF Standard Sheet 3-Iva, 3IVc)

IEC 61851-1 (FDIS)

- Clauses 6.2 and 6.3
- Clause 7
- Clause 8
- Clauses 12.1 to 12.4, 12.6
- Clauses 12.9 and 12.10
- Annex A

IEC 61851-23: 2013

- Clause 6 and 7
- Clause 10
- Clauses 101 and 102
- Annex AA
- Annex CC
- Annex EE
- Figures 101 to 105
- Figure AA.1 to AA.8
- Figures CC.1 to CC.6
- Tables 101 to 103
- Tables AA.1 to AA.6
- Tables CC1 to CC5

At the time of publication, this TR is expected to be used for public charging stations for EVs including the EV Phase 2 projects led by the Economic Development Board (EDB) and Land Transport Authority (LTA).

Attention is drawn to the possibility that some of the elements of this TR may be the subject of patent rights. Enterprise Singapore shall not be held responsible for identifying any or all of such patent rights.

Technical Reference for electric vehicle charging system

Section One – General requirements and a.c. electric vehicle charging station

1.1 Scope and objective

This Technical Reference is applicable to on-board and off-board equipment for charging electric vehicles in public or private car parks, public places and private residential premises at standard a.c. supply voltages up to 1000 V and at d.c. voltages up to 1500 V.

It covers the requirements for electrical installation, functional needs and safety, and connection to the electric vehicle.

The objective of this Technical Reference is to provide guidelines for electric vehicle charging system that aligns with currently accepted international practices and takes into consideration local conditions. It states the safety requirements to protect person and property against electrical hazards.

1.2 Normative references

The following referenced documents are indispensable for the application of Section One and Section Two of this Technical Reference. For dated references, only the edition cited applies. For undated references, the latest edition (including any amendments) applies.

SS CP 5	Code of practice for electrical installations
SS 97 : Part 1 : 2005	Residual current operated circuit-breaker without integral overcurrent protection for household and similar uses (RCCBs), Part 1 : General rules
IEC 60038	IEC standard voltages
IEC 60068	Environmental testing
	Part 2-1 : Tests – Tests A: Cold
	Part 2-5 : Tests – Test Sa: Simulated solar radiation at ground level and guidance for solar radiation testing
	Part 2-30 : Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)
	Part 2-52 : Tests – Test Kb: Salt mist, cyclic (sodium, chloride solution)
	Part 2-75 : Tests – Test Eh: Hammer tests
	Part 2-78 : Tests – Test Cab: Damp heat, steady state
IEC 60079	Explosive atmospheres
IEC 60245-1	Rubber insulated cables. Rated voltages up to and including 450/750 V
	Part 1 : General requirements
	Part 2 : Test methods
	Part 3 : Heat resistant silicone rubber insulated cables
	Part 4 : Cords and flexible cables
	Part 6 : Arc welding electrode cables

IEC 60309	Plugs, socket-outlets and couplers for industrial purposes Part 1 : General requirements Part 2 : Dimensional interchangeability requirements for pin and contact-tube accessories
IEC 60364-4-41	Low voltage electrical installations, Part 4-41 : Protection for safety – Protection against electric shock
IEC 60364-5-54	Low-voltage electrical installations, Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60664	Insulation coordination for equipment within low voltage systems, Part 1 : Principles, requirements and tests
IEC 60884	Plugs and socket-outlets for household and similar purposes Part 1 : General requirements Part 2-5 : Particular requirements for adaptors
IEC 60947	Low voltage switchgear and controlgear Part 1 : General rules Part 2 : Circuit-breakers Part 3 : Switches, disconnectors, switch-disconnectors and 307 fuse-combination units Part 4 : Contactors and motor starters – Electromechanical contactors and motor- starters
IEC 60950-1	Information technology equipment – Safety, Part 1 : General requirements
IEC 60990	Methods of measurement of touch current and protective conductor current
IEC 61000	Electromagnetic compatibility (EMC) Part 3-2 : Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase) Part 3-12 : Limits – Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase Part 6-1 : Generic standards – Immunity for residential, commercial and light-industrial environments Part 6-3 : Generic standards – Emission standard for residential, commercial and light-industrial environments
IEC 61008-1	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – General rules
IEC 61009-1	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – General rules
IEC 61140	Protection against electric shock. Common aspects for installation and equipment
IEC 61180-1	High-voltage test techniques for low voltage equipment, Part 1 : Definitions, test and procedure requirements
IEC 61316	Industrial cable reels

IEC 61439-1	Low voltage switchgear and controlgear assemblies, Part 1 : General rules
IEC TS 61439-7	Low-voltage switchgear and controlgear assemblies, Part 7 : Assemblies for specific applications such as marinas, camping sites, market squares, electric vehicles charging stations
IEC 61508 (all parts)	Functional safety of electrical/electronic/programmable electronic safety-related systems
IEC 61540	Electrical accessories – Portable residual current devices without integral overcurrent protection for household and similar use (PRCDs)
IEC 61558-1	Safety of power transformers, power supplies, reactors and similar products, Part 1 : General requirements and tests
IEC 61558-2-4	Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1100 V, Part 2-4 : Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers
IEC 61810-1	Electromechanical elementary relays, Part 1 : General requirements
IEC 61851	Electric vehicle conductive charging system
	Part 1 : General requirements
	Part 21 : Electric vehicle requirements for conductive connection to an a.c./d.c. supply
	Part 23 : DC electric vehicle charging station
	Part 24 : Digital communication between a d.c. EV charging station and an electric vehicle for control of d.c. charging
IEC 62196	Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles
	Part 1 : General requirements
	Part 2 : Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories
	Part 3 : Dimensional compatibility and interchangeability requirements for d.c. and a.c./d.c. pin and contact-tube vehicle couplers
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK Code)
IEC 62335	Circuit breakers – Switched protective earth portable residual current devices for class I and battery powered vehicle applications
IEC 62752	In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)
IEC CISPR 11	Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics - Limits and methods of measurement
IEC CISPR 16	Specification for radio disturbance and immunity measuring apparatus and methods
	Part 1-2 : Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements
	Part 2-3 : Methods of measurement of disturbances and immunity – Radiated disturbance measurements

ISO 6469-2	Electrically propelled road vehicles – Safety specifications, Part 2 : Vehicle operational safety means and protection against failures
ISO 15118-3	Road vehicles – Vehicle to grid communication interface, Part 3 : Physical and data link layer requirements
ISO 17409	Electrically propelled road vehicles – Connection to and external electric power supply – Safety requirements
SAE J1772	Electric vehicle conductive charge coupler

Transmission Code of Singapore (available online)

1.3 Definitions – a.c. charging

For the purpose of this Technical Reference, the following definitions apply: