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SERIES L: ENVIRONMENT AND ICTS, CLIMATE
CHANGE, E-WASTE, ENERGY EFFICIENCY;
CONSTRUCTION, INSTALLATION AND PROTECTION
OF CABLES AND OTHER ELEMENTS OF OUTSIDE
PLANT

Colour and marking identification of up to 400 VDC power distribution for information and communication technology systems

Recommendation ITU-T L.1203

ITU-T

ITU-T L-SERIES RECOMMENDATIONS

**ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION,
INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT**

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Recommendation ITU-T L.1203

Colour and marking identification of up to 400 VDC power distribution for information and communication technology systems

Summary

Recommendation ITU-T L.1203 defines the requirements and guidelines for DC power distribution identification by colour and marking in Telecom/ICT installations (wire, cables, electric distribution boards, interconnections, etc.). It avoids confusion and errors between the different AC and DC power interfaces and distributions used in buildings and inside Telecom/ICT systems, as 400 VDC power feeding interfaces standardized in Recommendation ITU-T L.1200 is used more, increasing power density of ICT equipment, energy efficiency, simplified reliable power feeding architecture, costs optimisation, etc. Recommendation ITU-T L.1203 supports the progressive introduction of up to 400 VDC installations in cohabitation with the existing –48 V and AC distribution.

History

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FOREWORD

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The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Introduction

This Recommendation has been developed to assist the ICT industry in their development and wider use of DC powering solutions above the DC voltage range mainly used until now for telecommunication networks equipment (–48 V ETSI [b-EN 300 132-2]).

This document was developed jointly by ETSI TC EE and ITU-T Study Group 5 and published as Recommendation ITU-T L.1203 and ETSI Standard ES 203 408, which are equivalent in technical content. DC has been the main source of power of the telecommunication industry since the very beginning as it is efficient, reliable and easily scalable.

This solution is a well proven arrangement that has been used for a century in almost all of the sites in cohabitation with AC for servers and other buildings services (lighting, facility plugs, lifts, etc.).

It is recognized that DC has many potential applications further to those for ICT and that such applications could benefit from ITU-T Recommendation and ETSI Standard. It is also recognized that further standardization activities on LVDC is now starting in other standardization organizations such as IEC. Thus ITU-T and ETSI will pursue cooperation with such organizations to reach maximum international alignment.

ETSI and ITU-T have standardized the widespread DC power interface at inputs of telecom/ICT equipment used in telecom networks, data centres, and customer sites. The legacy interface for billions of equipment is the SELV voltage range so called –48 V, where the plus pole is grounded as defined for example for interface "A" in [b-ETSI EN 300 132-2]. Other complementary ETSI standards define a whole DC distribution including earthing and bonding such as [b-ETSI EN 300 253].

Higher voltages than 48 V are already widely used in telecom networks for remote powering of signal repeaters on copper or optical telecom transmission lines, with a usual operation in symmetrical voltage up to ± 200 V in RFT-C or RFT-V telecom remote power feeding standardized in [b-ETSI EN 302 099].

Higher power density of ICT equipment and overall site power in MW for data centres, have led to the use of higher voltage firstly in AC single or 3 phases up to 400 VAC at the input of servers. The need for resilience, energy efficiency and cost optimization has pushed the introduction of the up to 400 VDC power feeding interface standardized in [b-ETSI EN 300 132-3-1] and in [ITU-T L.1200]. This is now available on many servers and network equipment.

As there is a progressive introduction of the new DC power interface in cohabitation with existing –48 V and AC distribution, a new standard [b-ETSI EN 301 605] was introduced to ensure safety and proper operation especially in mass bonding of EMC sensitive equipment and correct earthing connection to the building structure earthing network.

It appears that there is also a strong need for telecom/data centre operators, equipment manufacturers or installers and end customers to clarify the colour and marking of cables in their installations. This would avoid confusion and errors between the different AC and DC power interfaces and distributions used in the building and inside ICT systems.

Considering the user side and very long background experience in the use of DC by the telecom sector, this Recommendation aligns with the safety principles laid down in [b-IEC Guide 104] and [b-ISO/IEC Guide 51]. It accelerates and encourages the preparation of international standards of cable identification intended for use by manufacturers, users or certification bodies. This Recommendation makes reference to existing IEC standards such as [IEC 60445] and [b-IEC 60050-195].

Considering that DC is widely used in all electronic equipment, e.g., the electric circuit in cars and trucks, solar PV power plants, etc., Appendix I provides useful information on colours of cables inside equipment.

Recommendation ITU-T L.1203

Colour and marking identification of up to 400 VDC power distribution for information and communication technology systems

1 Scope

The scope of this Recommendation is to define common practice for identification of cabling or parts of the DC electric distribution inside buildings and rooms and inside telecom, ICT and facilities equipment (power plant, cooling, building access, monitoring, etc.).

This applies to 400 VDC cabling for telecom, ICT equipment and environment equipment using interface defined in [b-EN 300 132-3-1] or [ITU-T L.1200] and avoids confusion between the DC colour and marking of up to 400 VDC distribution and the other power interfaces identification: –48 VDC distribution for A interface, AC and uninterrupted AC given by inverters or UPS used in the building.

The Recommendation defines:

- requirements for the colour and identification of separate wires used in DC distribution systems and installations and as much as possible inside equipment between A or P interface and end use;
- marking and identification of DC multiwire cables, connectors and any associated equipment for DC power distribution;
- marking identification for sub-distribution boards and interconnection boxes.

For DC wires in multiwire cables, recommendations are given for harmonization with separate wire requirements.

Recommendations are given on other distribution items (wires, cables and interconnection items) including the functional earthing and bonding arrangement for distribution outside and inside equipment to avoid any confusion with DC distribution identification of this Recommendation.

2 Reference

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.1200] Recommendation ITU-T L.1200 (2012), *Direct current power feeding interface up to 400 V at the input to telecommunication and ICT equipment*.

[IEC 60417] IEC 60417DB (2002), *Graphical symbols for use on equipment*.

[IEC 60445] IEC 60445 Ed 5.0 (2010), *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*.

[IEC 60617] IEC 60617DB (2012), *Graphical symbols for diagrams*.

[IEC 60757] IEC 60757 (1983), *Code for designation of colours*.

NOTE – IEC DB documents refer to database of graphical symbol. Some are joint with ISO e.g., IEC 60417 and ISO7000.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 electrical equipment [b-IEC 60050-826]: Item used for such purposes as generation, conversion, distribution or utilization of electric energy, such as electrical machines, transformers, switch gear and control gear, measuring instruments, protective devices, wiring systems, current-using equipment.

3.1.2 line conductor [b-IEC 60050-195]: AC phase conductor or DC pole conductor (deprecated), conductor which is energized in normal operation and capable of contributing to the transmission or distribution of electric energy but which is not a neutral or mid-point conductor.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 identification: Colour, graphical symbol, text in alphanumeric notation located on or adjacent to wire or cable terminals or junction boxes.

3.2.2 48 VDC: Defines the –48 Volt Direct Current voltage range as standardized in [b-EN 300 132-2].

3.2.3 400 VDC: It defined up to 400 Volt Direct Current voltage range as standardized in [ITU-T L.1200].

3.2.4 IT: IT Isolation Terra is the two letter coding of one of the 3 families of earthing arrangements as defined in [b-IEC 60364-1], in which the electrical distribution is connected to earth through high resistance or impedance device i.e., HRMG in [b-EN 301 605].

3.2.5 RAL: Name of RAL colour coding for industry use.

4 Abbreviations and Acronyms

This Recommendation uses the following abbreviations and acronyms:

AC	Alternating Current
CMYK	Cyan, Magenta, Yellow, Key black
DC	Direct Current
HTML	Hypertext Mark-up Language
HRMG	High Resistance Middle point Grounding
PE	Protected Earthing conductor
PEL	Protective Earthing conductor and Line conductor
PEN	Protective Earthing conductor and Neutral conductor
RGB	Red Green Blue
RYB	Red Yellow Blue
3-D	3-Dimensional

5 Conventions

A (interface)	Name of ICT/telecom equipment –48 VDC power interface in [b-EN 300 132-2]
A3 (interface)	Name of ICT/telecom equipment up to 400 VDC power interface in ETSI [b-EN 300 132-3-1]
P	Name of ICT equipment up to 400 VDC power feeding interface in [ITU-T L.1200]

6 Electrical distribution identification coverage

The DC electrical distribution needs marking at the following different points:

- DC distribution lines (wires and cables);
- DC cabling inside DC power sources;
- DC outputs from DC power systems with protective devices;
- DC sub-distribution boards (with protective devices);
- DC interconnection boxes;
- DC power plugs strips inside ICT equipment rooms and cabinets.

Typical building and room distribution are provided in the following drawings:

- Building distribution with A or (–48 V) interface, with AC power from AC grid, or AC inverter outputs and with up to 400 VDC A3 or P interface. Figure 1 illustrates such building DC distribution and earthing-PE bonding in compliance with [b-EN 301 605] and [b-EN 300 253];
- Example of power feeding distribution of DC from centralized or decentralized permanent power supply at building or technical room level (Figure 2).