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Low and extra low voltage direct current power distribution in buildings

Blane Judd – Chair of the IET Standards Technical Committee 2.4 DC Power Systems responsible for developing the new IET *Code of Practice on Low and Extra Low Voltage Direct Current Power Distribution in Buildings* – writes about the growing significance of low and extra low voltage d.c. power distribution in buildings.

Introduction

As energy costs continue to rise, the pressure is increasing on engineers to make use of new and innovative solutions and alternative energy sources to power buildings. In order to respond to this demand engineers now need to take a more integrated approach to energy efficiency, looking to find opportunities to apply engineering solutions to existing innovation.

Low (and extra low) voltage d.c. power distribution infrastructure

The myths and misunderstandings – and even disagreements! – over the use of a.c. or d.c. for power distribution are deep-rooted, perhaps dating back to Edison, Tesla and Westinghouse. But, with increasing d.c. powered loads in building services (for example, in LED lighting circuits, portable device charging, access and security systems, or environmental control) and with almost every office desk now hosting several, often extremely inefficient, transformer/rectifier units (contributing to localised heating of the working space through I^2R losses), clients are looking to reduce power conversion losses without compromising performance or functionality while increasing the number of low voltage (LV) and extra low voltage (ELV) d.c. powered systems.

Dedicated d.c. power distribution infrastructure is emerging as a popular solution to this challenge, one with both standardised and proprietary approches that need to be appropriately managed. This concept is being adopted globally – for example through IEEE standards, or those under development through the EMerge Alliance – and it is therefore vital for UK professionals to have access to high-level knowledge that will prevent the UK from being left behind.

Standardised and proprietary solutions

One important consideration is the difference between standardised and proprietary solutions. The trend towards d.c. power distribution has been based, in part, on the use of telecommunications cabling infrastructure, which was not initially designed or installed for the delivery of power. As a result, there is a need to understand how to control provision of power over legacy cabling as well as the design of future installations. This is particularly important as much of the growth in this area is based upon the attachment of remote internet-protocol (IP) enabled devices, providing separated extra-low voltage (SELV) circuits, which are compliant with IEEE 802.3 – generally termed power over ethernet (PoE) circuits – that are evolving to increase the power level delivered over each cable.

It is critical to note that not all the implementations of ELV d.c. power distribution over telecommunications cabling infrastructures adopt the IEEE solutions. Some of these implementations are clearly proprietary but use power levels lower than those of the IEEE specifications, while others claim compliance but deliver power levels significantly in excess of those specifications. As a result, greater awareness needs to be applied in such circumstances, in relation both to the cabling and to the devices supplying and receiving the power.

Heating effects

While investigations into the heating effects of power delivery over telecommunications cabling infrastructures have been undertaken in accordance with the recognised structured (or generic) cabling standards (i.e. the BS EN 50173, ISO/IEC 11801 and ANSI/TIA-568 series), not all cables used in telecommunications cabling infrastructures are compliant with these standards and so these may experience significantly higher than expected temperature rises for a given level of current. In addition, some powering solutions use cabling infrastructures that are of proprietary design (i.e. not standards-based) but that are installed explicitly for the delivery of power using d.c. within the ELV or LV bands (for example, provision of 380-400 V d.c. supplies to equipment within data centres), while certain solutions employ existing mains power supply cabling converted to d.c. distribution.

The IET d.c. Code of Practice

The new IET *Code of Practice on Low and Extra Low Voltage Direct Current Power Distribution in Buildings* has been scoped and developed with an expert panel drawn from industry, academia and government, with the aim of helping to dispel many of the myths that have emerged about using LV and ELV d.c. power distribution. It aims to provide engineers, technicians and technical managers with an opportunity to engage constructively with d.c. power systems to achieve benefits such as integrated management of services, reductions in energy consumption and improvements in energy efficiency.

The Code of Practice sets out the requirements for the design, specification, selection, installation, commissioning, operation and maintenance of LV/ELV d.c. power distribution in buildings. It considers d.c. installations using telecommunications cabling, d.c. wiring or existing a.c. wiring infrastructure, including standardised solutions (such as PoE) as well as proprietary approaches for d.c. power distribution.

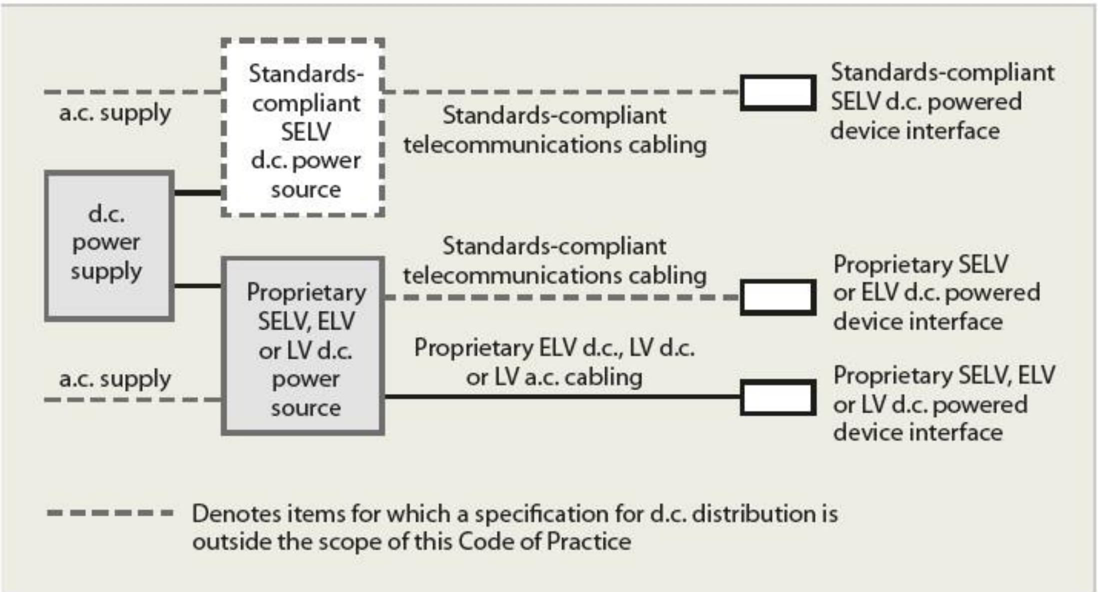


Figure 1: Schematic showing items within the scope of this Code of Practice (reused from the *Code of Practice on Low and Extra Low Voltage Direct Current Power Distribution in Buildings*, © The Institution of Engineering and Technology)

Next steps

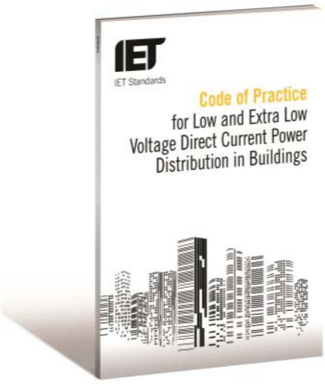
While the d.c. Code of Practice provides a strong start as the first consensus standard for use of d.c. infrastructure in buildings, there remain issues to be considered in the wider market, including around awareness, education (informed users) and supply chain development, i.e.:

- product availability (including relevant test/certification protocols) and costs – given that quality assurance will remain a key determinant of the future uptake of technologies at scale;
- customer education and raising awareness around the benefits that d.c. power systems can offer; and
- workforce competence (including training/certification) in the use of d.c. power systems – moving beyond specialist skills to build wider industry capability and market confidence.

In particular, electricians and installers need to understand the key differences between a.c. and d.c. systems, including such points as:

- disconnection under load;
- identification of conductor and wiring;
- Electro-magnetic Compatibility;
- d.c. termination;
- use of appropriate LV d.c. and/or ELV d.c. switchgear and protective devices; and
- understanding who has overall responsibility for the installation.

Further information



To learn more about d.c. power systems, why not attend the d.c. Code of Practice launch event – *Low Voltage Direct Current: Powering energy demands in our digital world* – which will be held on 18th June 2015 in London. Please visit: www.theiet.org/lvdc for more information.

For more detail on the *Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings*, due for publication in May 2015, please visit: www.theiet.org/dc-cop.