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TECHNICAL SPECIFICATION

AMENDMENT 1

Information technology – Telecommunications cabling requirements for remote powering of terminal equipment

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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FOREWORD

This amendment has been prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

The text of this amendment is based on the following documents:

DTS	Report on voting
JTC1-SC25/2919/DTS	JTC1-SC25/2945/RVDTS

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

INTRODUCTION to the amendment

This amendment incorporates changes necessary to include remote powering using single pair cabling.

Introduction

Add the following at end of the last paragraph:

This document addresses the use of generic balanced single pair cabling for customer premises, to be specified in future amendments of the ISO/IEC 11801 series, for remote powering of terminal equipment. This document uses measurements and empirical models to estimate the thermal performance of single pair cable bundles of various conductor diameters.

1 Scope

Replace list item a) with the following:

a) addresses the support of safety extra low voltage (SELV) and limited power source (LPS) applications that provide remote power over:
   - 4-pair balanced cabling in accordance with the reference implementations of ISO/IEC 11801 series standards using currents per conductor of up to 500 mA;
   - 1-pair balanced cabling using currents per conductor of up to 1 000 mA;

   and targets the support of applications that provide remote power over balanced cabling to terminal equipment,

5 Cabling selection and performance

Replace the first paragraph with the following:

Cabling for remote powering can be implemented using 4-pair and 1-pair balanced cabling.

6.3 Temperature rise and current capacity

Add the following new paragraph after the third paragraph:

The maximum current per conductor for different temperature rise in a bundle of 37 cables of 1-pair cables with 0,57 mm diameter conductors, and 37 cords of 1-pair 0,40 mm cords with all pairs energized is shown in Table 5.

Replace the fourth paragraph with the following new paragraph:

Annex B provides an engineering model that may be used for specific cable types, cable constructions, and installation conditions to derive the bundle size for a particular current per conductor. Clause B.7 describes a simplified version of the engineering model in Annex B and was used to derive the worst case values in Tables 1 to 9 based on constants calculated from measurements of typical cables for each cable category or conductor diameter. The measurement procedures used to determine the constants are detailed in Annex F.

Replace the Table 1 title with the following new title:

Table 1 – Maximum current per conductor versus temperature rise in a 37 4-pair cable bundle in air and conduit

Add the following new Table 5 after Table 1:

Table 5 – Maximum current per conductor versus temperature rise in a 37 1-pair cable bundle in air and conduit

Temperature rise °C	Current per conductor 0,57 mm diameter mA		Current per conductor 0,40 mm cords mA	
	air	conduit	air	conduit
5	866	738	608	518
7,5	1 061	904	744	634
10	1 225	1 044	860	732
12,5	1 370	1 167	961	819
15	1 501	1 278	1 053	897
17,5	1 621	1 381	1 137	969
20	1 733	1 476	1 216	1 036

Temperature rise above 10 °C shown in grey background is not recommended.

NOTE These values are based on conductor temperature measurement of typical cables and cords.

Replace the fifth paragraph with the following new paragraph:

Table 2 shows current capacity for different categories of 4-pair cable, independent of construction, for a given temperature rise. Table 6 shows current capacity for 1-pair cables of conductor diameters of cable, independent of construction, for a given temperature rise.

Add the following new Table 6 after Table 2:

Table 6 – Calculated worst case current per conductor versus temperature rise in a bundle of 37 1-pair cables of different conductor diameters in air and conduit

ΔT	**0,32 mm diameter** mA		**0,40 mm diameter** mA		**0,51 mm diameter** mA		**0,57 mm diameter** mA		**0,65 mm diameter** mA		**0,81 mm diameter** mA		**1,02 mm diameter** mA	
°C	**air**	**conduit**	**air**	**conduit**	**air**	**conduit**	**air**	**conduit**	**air**	**conduit**	**air**	**conduit**	**air**	**conduit**
2	307	262	384	327	490	417	548	466	624	532	779	663	981	835
4	435	370	543	463	693	590	775	660	883	753	1 101	938	1 387	1 181
6	533	454	666	567	849	723	949	808	1 082	922	1 349	1 149	1 699	1 446
8	615	524	769	655	981	835	1 096	933	1 249	1 065	1 558	1 327	1 962	1 670
10	688	586	860	732	1 096	934	1 225	1 044	1 397	1 190	1 742	1 484	2 194	1 867
12	753	642	942	802	1 201	1 023	1 342	1 143	1 530	1 304	1 908	1 625	2 403	2 046
14	814	693	1 017	867	1 297	1 105	1 450	1 235	1 653	1 409	2 061	1 755	2 596	2 210
16	870	741	1 087	926	1 387	1 181	1 550	1 320	1 767	1 506	2 203	1 877	2 775	2 362
18	923	786	1 153	983	1 471	1 253	1 644	1 400	1 874	1 597	2 337	1 991	2 943	2 506
20	973	829	1 216	1 036	1 551	1 321	1 733	1 476	1 976	1 684	2 463	2 098	3 102	2 641

Temperature rise above 10 °C shown in grey background is not recommended.

The values in this table are based on the implicit DC resistance derived from the insertion loss of the various conductor diameters of cable. Manufacturers' and/or suppliers' specifications give information relating to a specific cable.

NOTE The current per conductor for each 1-pair cable is also dependent on the cable construction.

6.4.3 Cable count within a bundle

Replace the first paragraph with the following new paragraphs:

This document uses 37-cable bundles as the basis for developing the temperature rise and current per conductor with all pairs energized. For other cases (e.g. where bundle count exceeds 37 cables), the guidelines provided in 6.4 can be used.

Refer to Table 3 to determine the maximum temperature rise using 500 mA per conductor for 4-pair cable bundles of different count.

Refer to Table 7 to determine the maximum temperature rise using 1 000 mA per conductor for 1-pair cable bundles of different count.

Replace the Table 3 title with the following new title:

Table 3 – Temperature rise versus 4-pair cable bundle size (500 mA per conductor)

Add the following new Table 7 after Table 3:

Table 7 – Temperature rise versus 1-pair cable bundle size (1 000 mA per conductor)

Number of cables	Temperature rise °C													
	0,32 mm diameter mA		0,40 mm diameter mA		0,51 mm diameter mA		0,57 mm diameter mA		0,65 mm diameter mA		0,81 mm diameter mA		1,02 mm diameter mA	
	air	conduit	air	conduit	air	conduit	air	conduit	air	conduit	air	conduit	air	conduit
1	2,9	4,4	1,9	2,8	1,1	1,7	0,9	1,4	0,7	1,1	0,5	0,7	0,3	0,4
7	8,2	11,9	5,2	7,6	3,2	4,7	2,6	3,8	2,0	2,9	1,3	1,9	0,8	1,2
19	14,3	20,2	9,2	12,9	5,6	8,0	4,5	6,4	3,5	4,9	2,2	3,2	1,4	2,0
24	16,4	23,0	10,5	14,7	6,4	9,0	5,2	7,2	4,0	5,6	2,6	3,6	1,6	2,3
37	21,1	29,1	13,5	18,6	8,3	11,5	6,7	9,2	5,1	7,1	3,3	4,5	2,1	2,9
48	24,7	33,6	15,8	21,5	9,7	13,2	7,8	10,6	6,0	8,1	3,9	5,2	2,4	3,3
52	25,9	35,2	16,6	22,5	10,2	13,8	8,2	11,1	6,3	8,5	4,0	5,5	2,5	3,5
61	28,6	38,5	18,3	24,6	11,3	15,1	9,0	12,1	6,9	9,3	4,5	6,0	2,8	3,8
64	29,4	39,5	18,8	25,3	11,6	15,6	9,3	12,5	7,1	9,6	4,6	6,2	2,9	3,9
74	32,2	42,9	20,6	27,5	12,7	16,9	10,2	13,5	7,8	10,4	5,0	6,7	3,2	4,2
91	36,7	48,4	23,5	31,0	14,5	19,0	11,6	15,2	8,9	11.7	5,7	7,5	3,6	4,8

Temperature rise above 10 °C shown in grey background is not recommended.

The values in this table are based on the implicit DC resistance of the various conductor diameters of cable. Manufacturers' and/or suppliers' specifications give information relating to a specific cable.

NOTE 1 The temperature rise (°C) is based upon a current of 1 000 mA per conductor, for all cables in the bundle.

NOTE 2 The current per conductor for each conductor diameter is also dependent on the cable construction.

6.4.4 Reducing temperature increase

Replace the first dashed item with the following:

– using higher category cable (for 4-pair cables),

Replace the fifth paragraph ("Table 4 shows …") with the following new paragraphs:

Table 4 shows the effect of energizing the number of pairs within a 37-cable bundle for different 4-pair cable categories.

Table 8 shows the effect of energizing the number of pairs within a 37-cable bundle for different 1-pair cable constructions in air. Figure 1 shows this data in graphical form.

Table 9 shows the effect of energizing the number of pairs within a 37-cable bundle for different 1-pair cable constructions in conduit. Figure 2 shows this data in graphical form.

In the sixth paragraph, replace: "cable bundles" *with* "4-pair cable bundles".

Replace the Table 4 title with the following new title:

Table 4 – Temperature rise for a type of 4-pair cable versus the number of energized pairs in a 37-cable bundle (500 mA per conductor)

Add the following new Table 8 after Table 4:

Table 8 – Temperature rise for a 0,57 mm conductor diameter 1-pair cable versus current for different bundle sizes in air

Bundle size	Δ*T* (°C)				
	Current (mA)				
	200	**400**	**600**	**800**	**1 000**
7	0,103	0,413	0,93	1,653	2,582
19	0,18	0,722	1,624	2,887	4,511
37	0,266	1,065	2,396	4,26	6,656
61	0,36	1,442	3,244	5,767	9,01
91	0,463	1,852	4,166	7,407	11,573

Temperature rise above 10 °C shown in grey background is not recommended.

The values in this table are based on the DC resistance of the cable conductors. Manufacturers' and/or suppliers' specifications give information relating to a specific cable.

NOTE The temperature rise for a particular cable is also dependent on the cable construction.

Insert the following new Figure 3 after Table 8:

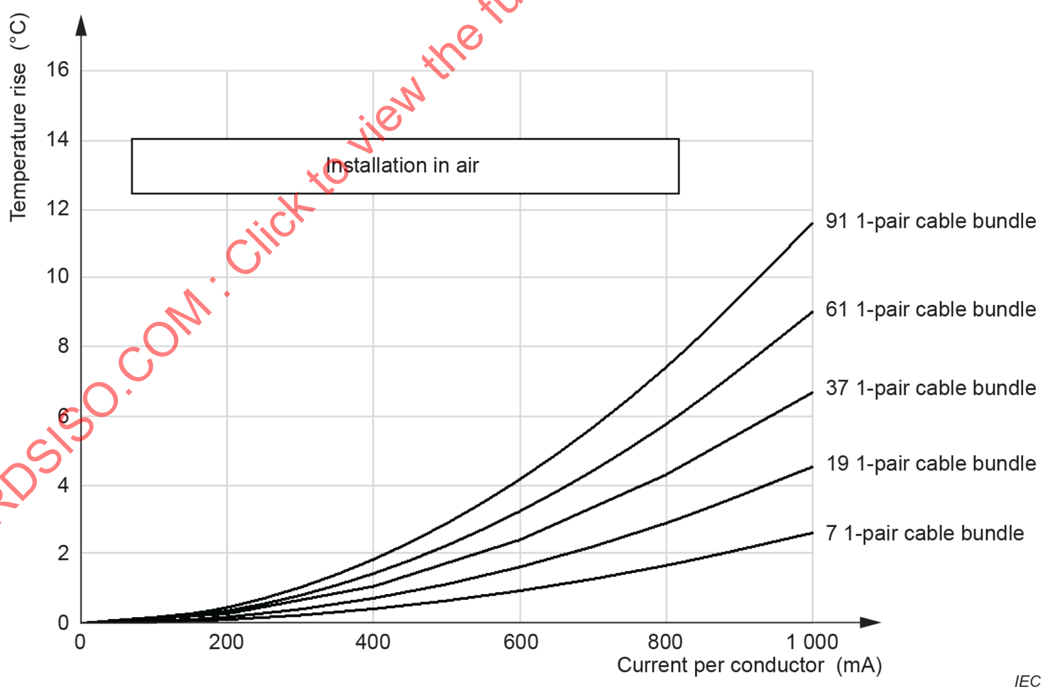

Figure 3 – Temperature rise for a 0,57 mm conductor diameter 1-pair cable versus current for different bundle sizes in air

Insert the following new Table 9 after Figure 3:

Table 9 – Temperature rise for a 0,57 mm conductor diameter 1-pair cable versus current for different bundle sizes in conduit

Bundle size	**Δ*T*** (°C)				
	Current (mA)				
	200	**400**	**600**	**800**	**1 000**
7	0,15	0,6	1,351	2,401	3,752
19	0,255	1,02	2,295	4,081	6,376
37	0,367	1,467	3,302	5,87	9,171
61	0,485	1,941	4,366	7,762	12,128
91	0,61	2,439	5,488	9,756	15,244

Temperature rise above 10 °C shown in grey background is not recommended.

The values in this table are based on the DC resistance of the cable conductors. Manufacturers' and/or suppliers' specifications give information relating to a specific cable.

NOTE The temperature rise for a particular cable is also dependent on the cable construction.

Insert the following new Figure 4 after Table 9:

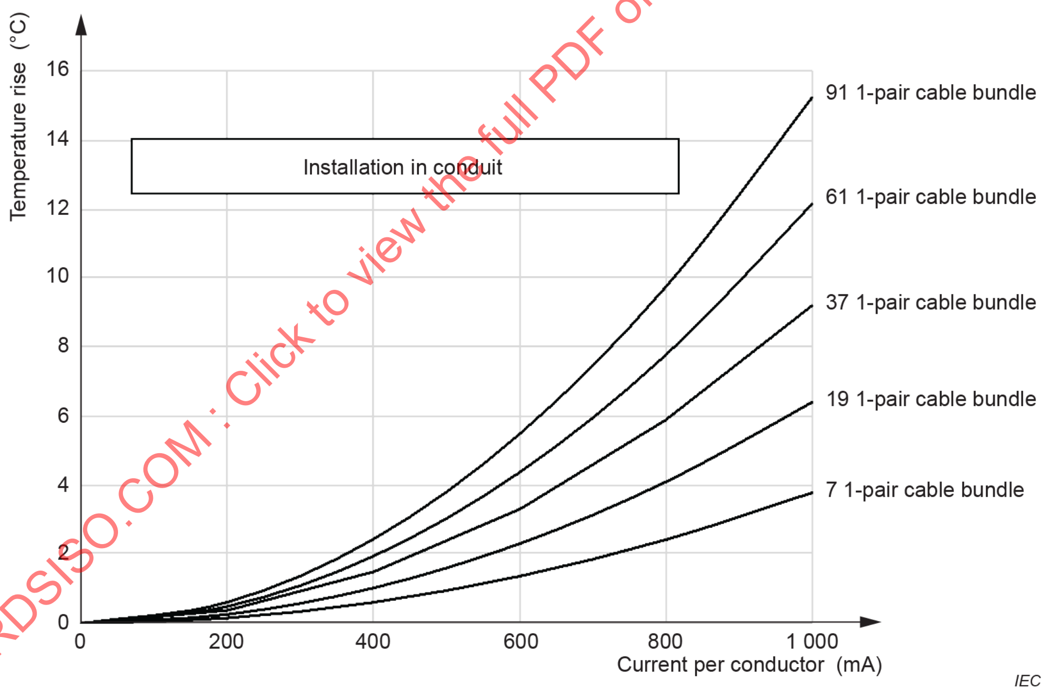

Figure 4 – Temperature rise for a 0,57 mm conductor diameter 1-pair cable versus current for different bundle sizes in conduit

7 Remote power delivery over balanced cabling

Add the following new subclause title before the first paragraph:

7.1 4-pair balanced cabling

Add the following new subclause after the last paragraph:

7.2 1-pair balanced cabling

Figure 5 shows examples of specified transmission paths used in 1-pair balanced cabling. The channel is the transmission path between equipment such as a LAN switch or hub and the terminal equipment. The channel does not include the connections at the data source equipment and the terminal equipment. The channel, the permanent link or the CP link shall meet the transmission requirements specified in the design standards.

Remote power may be provided to terminal equipment via balanced cabling equipment interfaces. Remote power is introduced to the balanced cabling channel at the Floor Distributor using the phantom circuit of data pairs from the power sourcing equipment, as shown in Figure 5.

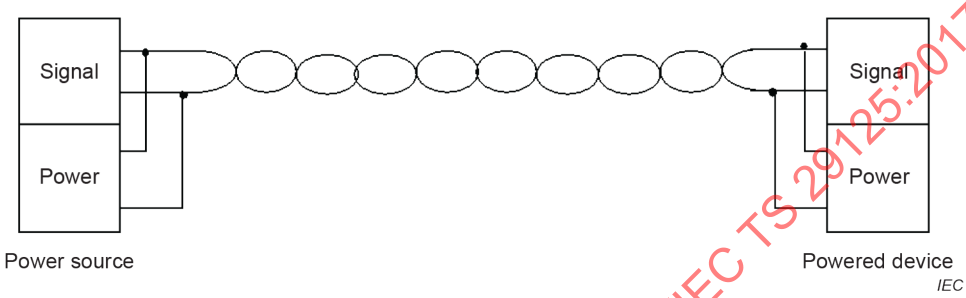

Figure 5 – Single pair remote powering using signal pairs

When mid-span power source equipment replaces a generic balanced cabling component or components, the data pair shall meet the performance requirements of the component or components it replaces (e.g. patch cord, patch panel or combination thereof), regardless of the equipment interfaces used for input and output connections.

8 Connecting hardware

Add the following new subclause title before the first paragraph:

8.1 General

Add the following new subclause title after the sixth paragraph:

8.2 4-pair balanced cabling

Move the first paragraph in 8.1 to become the first paragraph in 8.2.

Add the following new subclause after the NOTE:

8.3 1-pair balanced cabling

Contacts need to support 2,0 A for mating and un-mating under load.

Connecting hardware in channels used to support remote power applications shall have an appropriate current rating when mated. Connecting hardware contacts may deteriorate as a result of mating or un-mating under electrical load, leading to possible degradation of transmission characteristics (IEC 60512-99-002). Manufacturers should be consulted regarding the number of mating and un-mating cycles supported by connecting hardware while conveying the intended levels of electrical power.

NOTE A test schedule for engaging and separating connectors under electrical load is described in IEC 60512-99-002.

B.10 Coefficients for air and conduit

Replace the first paragraph with the following new paragraphs:

Table B.1 shows the bundling coefficients determined from measurements for the different 4-pair cables and cords using at least two different bundle sizes (e.g. 37 and 61 cables per bundle).

Table B.2 shows the resistance per metre and the bundling coefficients determined from measurements for the different 1-pair cables and cords using at least two different bundle sizes (e.g. 37 and 19 cables per bundle).

See Annex F for a recommended method to determine the constants for different types of cables and cords.

Replace the Table B.1 title with the following new title:

Table B.1 – Bundling coefficients for different types of 4-pair cables and cords (all 4 pairs energized) in air and conduit

Insert the following new Table B.2 after Table B.1:

Table B.2 – DC resistance and bundling coefficients for 1-pair cables of different conductor diameters (all conductors energized) in air and conduit

Conductor diameter	R	Bundling coefficients			
		in air		in conduit	
mm	Ω/m	C_1	C_2	C_1	C_2
0,32	0,220 2	0,109 1	0,885	0,026 1	1,349
0,40	0,140 9	0,069 9	1,797	0,053	2,739
0,51	0,086 7	0,043	1,105	0,032 6	1,685
0,57	0,069 4	0,034 4	0,885	0,026 1	1,349
0,65	0,053 4	0,026 5	0,680 6	0,020 1	1,037
0,81	0,034 4	0,017	0,438 3	0,012 9	0,668
1,02	0,021 7	0,010 7	0,276 4	0,008 2	0,421 3
NOTE The bundling coefficients are directly proportional to the square of the ratio of the two conductor diameters.					

C.1 DC loop resistance

Add the following new subclause title before the first paragraph:

C.1.1 4-pair cabling

Add the following new subclause title and paragraphs before the second paragraph:

C.1.2 1-pair cabling

The DC loop resistance requirements of a 1-pair channel can be calculated using Table B.2 for DC resistance of 90 m of single pair cables, 10 m of single pair cords, and 4 connections with 0,10 Ω per connection. For example, for a T1-B channel the maximum DC resistance is typically 17 Ω.

The DC loop resistance is dependent on the conductor diameter and length of the cabling. Selecting a larger conductor diameter is one way to reduce DC loop resistance and improve both energy consumption and heating. Careful attention to cable routing to minimize cable lengths will substantially decrease DC loop resistance.

C.2 DC resistance unbalance (within pair)

Add the following new subclause title before the first paragraph:

C.2.1 General

Delete the first paragraph of C.2.1.

Add the following new subclause title and paragraph before Table C.2:

C.2.2 4-pair cabling

The DC resistance unbalance requirements of each pair of a cable, connector, or channel are specified in ISO/IEC 11801-1. For convenience, Table C.2 shows those requirements as shown in Formula (C.1).

Replace the Table C.2 title with the following new title:

Table C.2 – DC resistance unbalance of 4-pair cables, connecting hardware and channels

Add the following new subclause after Table C.2:

C.2.3 1-pair cabling

The DC resistance unbalance requirements of each pair of a cable, connector, or channel are expected to be similar to those of Category 5 components of Table C.2.

E.2 Test set-up

Replace the first paragraph with the following new paragraph:

All tests shall be undertaken on bundles containing 37 cables each having a nominally circular cross-section. This quantity is used in order to produce a cable bundle with three complete layers surrounding a centre cable as shown in Figure E.1.

Replace the third paragraph ("The cables are configured …") with the following new paragraph:

The cables are configured to allow the balanced pair within them to be fed with a constant current. The test shall be coupled with all conductors in series so the same current is flowing through the whole set-up as shown in Figure E.3 for 4-pair cabling and Figure E.4 for 1-pair cabling.

Replace the Figure E.3 title with the following new title:

Figure E.3 – 4-pair cabling conductor configuration