2nd Draft **ISO/IEC JTC 1/SC 25/WG 3 N 764**

Date: 2005-10-15

Replaces ISO/IEC JTC 1/SC 25/WG 3 N n/a

Customer Premises Cabling
Secretariat: Germany (DIN)

DOC TYPE:	**Liaison Report**
TITLE:	**Draft liaison report to the IEEE 802.3at PoEP Task Group on power feeding via balanced channels**
SOURCE:	**WG 3 Secretariat** (v. Pattay)
PROJECT:	**25.03.02.xx: Generic cabling for customer premises**
STATUS:	**Draft to be developed by correspondence as requested for by WG 3 at Edinburgh, UK, 2005-09-26/29 and subject to synchronisation with IEC SC 46C & SC 48B as requested by SC 25 plenary 2005-09-30.** **1st Step the draft is sent to SC 25/WG 3 experts for comments** (due to their meeting schedules IEEE 802.3at PoEP, IEC SC 46C & SC 48B are already included in this comment cycle with the request for input). **2nd step the completed draft is sent to IEC SC 46C & SC 48B with the request to include answers to the open questions and for endorsement/update of data on their products already included.** **3rd step the liaison report is completed and forwarded to IEEE 802.3.**
ACTION ID:	**FYI**
DUE DATE:	**2005-11-04**
REQUESTED: ACTION	**This draft is distributed in SC 25/WG 3 with the kind request for comments. Should IEEE 802.3, IEC SC 406C and SC 48B already have comments at that early status they will also be taken into account.**
MEDIUM:	**Def**
NOTE:	**Electronically this document consists of two files: WG3N764c and WG3N764x.**
No of Pages:	**7 (including cover)**

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Secretary - ISO/IEC JTC 1 / SC 25/WG 3 - Dr.-Ing. Walter P. von Pattay
ZVEI FV 7 & FV 8, Gotthelfstraße 24, D- 81677 München, Germany
Tel.: +49/89/923 967 57, Tfx,: +49/89/923 967 59 (on request only)
EM: Walter@Pattay.com
Home page SC 25: "http:/www.iec.ch/sc25"

SC 25/WG 3 is pleased to address the needs of IEEE 802.3 as to power feeding over the premises cabling system.

Though SC 25/WG 3 is happy to share its findings with IEEE 802.3at, SC 25/WG 3 has to emphasise the fact that these findings have to be considered as preliminary as many findings are subject to confirmation by the relevant component committees, i.e. IEC 46C and IEC 48B.

1 Introduction

In its investigations on the power carrying capacity of balanced cabling channels, ISO/IEC JTC 1/SC 25/WG 3 has identified three fields of investigation that are discussed under point 3 for cables and point 4 for connecting hardware and that need to be further explored:

1. **Change of transmission characteristic**
2. **Long term stability**
3. **Safety and local regulations**

It should be noted, that the channel carrying performance is determined per characteristic by the component with the lowest performance.

During its investigations SC 25/WG 3 also has identified a number of questions to IEEE 802.3at which are addressed in point 0 below.

To simplify matters the relevant articles of ISO/IEC 11801:2002 are listed under point 2. further details on the application and its wishes are provided in point 7.

2 Content of ISO/IEC 11801:2002

4 Conformance

h) Regulations on safety and EMC applicable at the location of the installation shall be met.

6.4.9 Current carrying capacity (of the channel)

The minimum current carrying capacity for channels of Classes D, E and F shall be 0,175 A d.c. per conductor for all temperatures at which the cabling will be used. This shall be achieved by an appropriate design.

6.4.10 Operating voltage (of the channel)

The channels of classes D, E and F shall support an operating voltage of 72 V d.c. between any conductors for all temperatures at which the cabling is intended to be used.

6.4.11 Power capacity (of the channel)

The channels of classes D, E and F shall support the delivery of a power of 10 W per pair for all temperatures at which the cabling is intended to be used.

It should be noted that all three values specify maxima for the application that all apply individually and therefore can not be exploited at the same time.

Table 21 of ISO/IEC 11801

specifies the worst-case for the degradation of insertion loss of balanced channels for operating temperatures above 20 °C, with 0,2 % per °C for channels implemented with screened cables; and with 0,4 % per °C (20 °C to 40 °C) and 0,6 % per °C (>40 °C to 60 °C) for unscreened cables.

Implicitly the values specified in table 21 also characterise the cables.

9.2.2.6 Current carrying capacity (of the cable)

Minimum d.c. current carrying capacity per conductor shall be 175 mA. This shall be supported at a maximum ambient temperature of 60 °C

Table 38 – Current carrying capacity (of IEC 60603-7 connecting hardware)

Electrical characteristics	Frequency	Requirement			Test standard
		Connector category			
		5	6	7	
Minimum current carrying capacity [a, b, c] A	d.c.	0,75	0,75	0,75	IEC 60512-3 Test 5b

[a] Applicable for an ambient temperature of 60 °C.

[b] Sample preparation shall be as specified in IEC 60603-7 (unscreened) or IEC 60603-7-1 (screened).

[c] Applicable to each conductor including the screen, if present.

3 Cables

3.1 Change of transmission characteristics

The following characteristics may change with temperature:

a) The worst-case effect of temperature according to the present knowledge of SC 25/WG 3 is on the attenuation.

b) The phase angle and as a result the propagation velocity are expected to be only to a minor degree affected.

c) The delay skew is, as a result, should be affected in a negligible way.

d) NEXT (expectations no more than ~ 0,5 dB on 100 m of cable)

e) ELFEXT and ACR-F (mainly due to the impact of the attenuation).

f) The impedance should be relatively stable over temperature range considered here.

The following changes of transmission characteristics have been confirmed by IEC SC 46C:

Room for additional input from IEC SC 46C

SC 25/WG 3 expects IEC SC 46C to provide further verification/quantification of cable behaviour.

Therefore IEEE 802.3 is kindly asked to note that these investigations may take some time since readily available data implies that the currents carried are so small as to allow assuming that the conductor surface temperature and the ambient operating temperature are practically equal.

3.2 Long term stability

This issue affects the main two components of the cabling channels, i.e. cables and connectors in a different way that need further investigations.

Cables, long term exposed to elevated temperatures (aging and eventually humidity), may be affected in their performances. The range of possible effects is expected to be considerable depending on their design and the materials used.

Room for input from IEC SC 46C

3.3 Safety and compliance to local regulations

Safety is not covered in ISO/IEC 11810, as it is normally a locally regulated issue (see excerpt from clause 4 of ISO/IEC 15018 copied above) as it is outside the scope of SC 25, and WG 3 can only indicate areas of possible concern.

Such concerns have been expressed and led to three questions.

Could the current asked for by IEEE 802.3 make the IT cables subject to power cable regulations?

Could the current asked for by IEEE 802.3 heat the IT cables beyond the temperature they have been rated for?

Could the current asked for by IEEE 802.3 heat the IT cables to temperatures that are not considered to be safe?

These questions need and will be investigated by SC 25.

Room for additional input from IEC SC 46C

4 Connecting hardware

4.1 Change of transmission characteristics

Un-plugging under load: The specifications of IEC 60603-7 so far do not contain requirements for mating and un-mating under load. IEC 60512-9-3 specifies a test method to qualify any connector for those characteristics. Also ISO/IEC 11801 so far neither requires that the connector (according to IEC 60603-7-x or IEC 61076-3-104) used within any channel specified in ISO/IEC 11801 needs to pass the test according to IEC 60512-9-3 nor does it specify the limits for such a test that would be appropriate for generic cabling channels .

Room for additional input from IEC SC 48B

4.2 Long term stability

Connectors are affected in their long term stability primarily due to the anticipated plugging and unplugging, where primarily the latter may be under load. This may result in a change of performance with respect to contact resistance, and may have as a result also an impact on the consecutive heating of the connector under load. Depending on the specific construction such effects could be dramatic.

Room for additional input from IEC SC 48B

4.3 Safety and local regulations

Again, safety of the connecting hardware is not covered in ISO/IEC 11810, as it is normally a locally regulated issue. Safety is outside the scope of SC 25/WG 3.

IEC SC 48B has emphasised in a liaison document (Zurich 17) that safety is the responsibility of the application that uses connecting hardware. The mating interface of IEC 60603-7 itself is not designed to fulfil the safety requirements to prevent users from electrical shock (i.e. finger probe test according to IEC 60529).

Room for additional input from IEC SC 48B

5 Questions to IEEE 802.3

IEEE 802.3 needs to clarify the circuit components representing the load for un-plugging. So far IEEE 802.3 indicates 0,420 A for the component calculation, though the actual current, according to the sketch, over the common mode circuit of two pairs is 0,840 A. The components representing the worst case capacitance and inductance of the channel will have to be added to this circuit in determining the requirements for the test according to IEC 60512-9-3.

Could you please confirm, that your application would only put power on the channel ?? ms after the terminal has been connected, that the power will be switched of before intended and within 500 ms after unintended disconnection of the terminal. These values are essential for the input expected from IEC SC 48B.

What is the maximum current in any direction, irrespective of the number of pairs shared? There may be cases where the full current will flow through a single conductor, since the contact break upon unplugging will definitely occur sequentially, so concentrating the current on the last mated conductor.

Room for additional input from IEEE 802.3

6 Preliminary conclusion

SC 25/WG 3 notes that ISO/IEC 11801 specifies generic channels that are capable to support all the applications satisfied within the frequency range a specific channel is specified.

Please also note that SC 25 may only specify the characteristics of channels installed after publication of the appropriate standard. SC 25 also notes that up to now it was a basic assumption to ISO/IEC 11801 that the conductor surface temperature and the ambient operating temperature are practically equal.

SC 25 is concerned primarily with the transmission performance of channels, while physical safety, construction of components and behaviour of material belong to the scope of other committees.

SC 25 – even with help of the component committees – is not optimistic with respect to finding a widely applicable way to qualify channels for power distribution exceeding the level of a specific installation at the time of installation retroactively. The qualification of installed channels would require knowledge about components' construction and materials that can not be acquired with measurement of installed channels. In many cases only the source of the component itself will be able to provide such data. Nevertheless SC 25 attempts to identify ranges of environmental conditions and component constructions that have a reasonable probability to work above the minimum specified in ISO/IEC 11801.

NOTE While ISO/IEC 11810 specifies the **minimum** performance a channel has to provide in order to meet the standard, this same value from the point of view of the application it is the **maximum** value it may expect from any channel installed according to this standard.

This may also lead to the specification of additional environmental and possibly other conditions that need to be met in order to exploit the 175 mA presently specified.

SC 25 anticipates that the cable committee will recommend a reduction of the maximum applicable ambient operating temperature. Whether the cable industry will also offer solutions for an ambient temperature of 60 °C and what (additional) conditions need to be met so that such solutions are authorised by regulatory bodies is open.

The intent to go to higher currents than 175 mA on channels implemented with current constructions of cables and IEC 60603-7-x connectors raises concerns that need further investigation. To meet this intent is expected to require changes to component specifications that need to be justified by a significant gain in user benefit. Explanations of that user benefit would be welcome.

7 Further information on the application

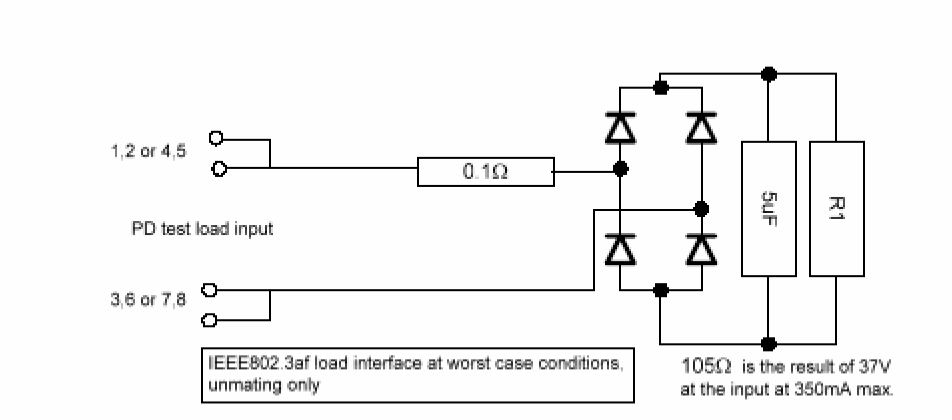
7.1 Request for higher current and power

The IEEE PoEPlus Study Group is investigating raising the current above the 175 mA minimum capability specified in ISO 11801 section 6.4.9. We have not yet determined an appropriate maximum current, but are evaluating currents as high as 420 mA per conductor and operating at a maximum voltage of 57 Vdc. We require guidance from SC25 on how to achieve these goals on installed cabling.

7.2 Decreased requirement on connecting hardware

IEEE Std 802.3af-2003 loads are not consistent with the circuit used to test connector mating and unmating under load. Specifically, our devices ensure that:

- sources and loads are never active during mating, and,
- the load during unmating is as shown in the schematic below:



Given the load circuit above and an appropriate power source which powers the load only after mating has completed, what would be the maximum load which may be repetitively unplugged without performance degradation? Note that in the above circuit with R1=105Ω this would represent a 13 Watt load at 37 Vdc, which is the worst case for IEEE Std 802.3af-2003; however, as stated earlier we are evaluating 51 Vdc and 420 mA per conductor which would require R1=60Ω.

7.3 Details on current hoped for

ISO 11801 specifies the minimum current capacity to be 175 mA per conductor while IEEE Std 802.3af-2003 specifies the maximum sustained current per conductor pair to be 350 mA with a maximum conductor imbalance of 10,5 mA. The standard also allows for up to 50 ms of operation at currents as high as 400 mA limited to a duty cycle of no more than 5%. Do these minor variations merit further investigation?

Room for additional input from IEEE 802.3.