FINAL DRAFT

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Interconnection of information technology equipment — Control Network Protocol —

Part 2: Twisted-pair communication

Interconnexion des équipements des technologies de l'information — Protocole de réseau de contrôle — Partie 2: Communication de paire torsadée

Please see the administrative notes on page iii

Reference number
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In accordance with the provisions of Council Resolution 15/1993, this document is **circulated in the English language only**.

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 14908-2 was prepared by CEN/TC 247, was adopted, under the fast track procedure, by joint Technical Committee ISO/IEC JTC 1, *Information technology*, and was assigned to SC 25, *Interconnection of information technology equipment*. It was then transferred to ISO/TC 205, *Building environment design*.

ISO 14908 consists of the following parts, under the general title *Interconnection of information technology equipment — Control Network Protocol*:

— *Part 1: Protocol Stack*

— *Part 2: Twisted-pair communication*

— *Part 3: Power line channel specification*

— *Part 4: IP communication*

Introduction

This International Standard has been prepared to provide mechanisms through which various vendors of local area control networks may exchange information in a standardized way. It defines communication capabilities.

This International Standard is to be used by anyone involved in design, manufacture, engineering, installation and commissioning activities.

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Interconnection of information technology equipment — Control Network Protocol —

Part 2: Twisted-pair communication

1 Scope

This part of ISO 14908 specifies the control network protocol (CNP) free-topology twisted-pair channel for networked control systems in local area control networks and is used in conjunction with ISO 14908-1. The channel supports communication at 78,125 kbit/s between multiple nodes, each of which consists of a transceiver, a protocol processor, an application processor, a power supply and application electronics.

This part of ISO 14908 covers the complete physical layer (OSI Layer 1), including the interface to the Media Access Control (MAC) sub-layer and the interface to the medium. Parameters that are controlled by other layers, but which control the operation of the physical layer, are also specified.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14908-1:2011, *Interconnection of information technology equipment — Control Network Protocol — Part 1: Protocol Stack*

ISO/IEC 15018:2004, *Information technology — Generic cabling for homes*

3 Network overview

The CNP free-topology twisted-pair channel supports up to 128 nodes on a single network segment with an optional link power source that supplies DC power to the nodes on the network. The channel is specified to support free-topology wiring, and will accommodate bus, star, loop, or any combination of these topologies. The total network length and number of nodes may be extended by use of CNP channel physical layer repeaters, or CNP compliant routers. The channel data rate is 78,125 kbit/s. Nodes can be either locally powered or link powered. A link-powered node derives its power from the network. The power is delivered on the same two conductors that carry data. Nodes are polarity-insensitive with respect to data as well as DC power. A locally powered node derives its power from a local source. The data is transmitted using Differential Manchester encoding, which is polarity-insensitive.

4 System specifications

4.1 General aspects

This section specifies the cable type used, terminations required with bus or free topology, maximum node counts and distances for link and locally powered schemes, and the maximum steady state power that can be drawn from the link power supply.

4.2 Cable

The cable shall conform to 9.4 of ISO/IEC 15018:2004.

4.3 Topology

4.3.1 Free or bus topology

The network may use either a singly-terminated free topology or a doubly-terminated bus topology.

4.3.2 Repeater

Two network segments may be interconnected with a channel physical layer repeater. No more than one physical layer repeater shall be in a path between any two nodes on a network. Physical layer repeaters shall not be interconnected in such a way as to create a loop.

Each port of a physical layer repeater shall meet the specifications stated in 6.2, 6.3.3, and 6.4. The delay through the repeater shall not exceed 36 µs.

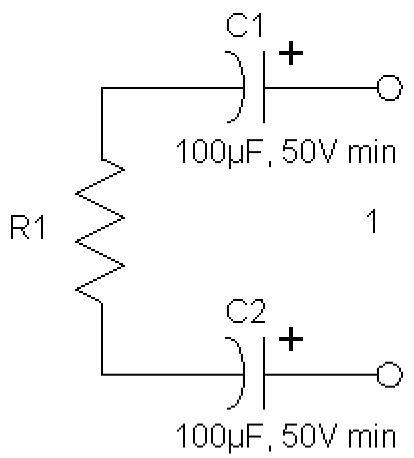
4.4 Cable termination

4.4.1 Free-topology segment

A free-topology segment shall have a single termination. If the segment is locally powered, an RC network as shown in Figure 1 shall be used, with R1 = 52,3 Ω ± 1 %, 1/8 W. The termination may be located anywhere on the segment. If the segment is link-powered, the termination shall be provided by the link power source. See Figure 5. The link power source and termination may be located anywhere on the segment.

4.4.2 Bus topology segment

A bus topology segment shall have two terminations, one at each end of the bus. If the segment is locally powered, an RC network as shown in Figure 1 shall be used, with R1 = 105 Ω ± 1 %, 1/8 W at each end. If the segment is link-powered, the link power source shall provide one termination. See Figure 5. The other termination shall be an RC network as shown in Figure 1, with R1 = 105 Ω ± 1 %, 1/8 W.



Key

1 Network Connection

Figure 1 — Termination

4.5 Segment configuration

A free-topology twisted-pair channel shall support up to 128 link-powered or 64 locally-powered nodes at a maximum bit error rate of 1 in 100 000. Both types of nodes shall be supported on a given segment, provided the following constraint is met:

(1 × number of link powered nodes) + (2 × number of locally powered nodes) ≤ 128

Table 1 shows the maximum bus length for a bus-topology segment.

Table 2 shows the maximum node-to-node distance and maximum wire length for a free-topology segment. The distance from each node to each of the other nodes and to the link power source shall not exceed the maximum node-to-node distance. If multiple paths exist, e.g., a loop topology, then the longest path shall be used for the calculations. The maximum wire length is the total amount of wire connected to a network segment.

Table 1 — Bus-Topology Distance Specifications

Maximum bus length	Maximum stub length	Units
600	3	m

Table 2 — Free-Topology distance specifications

Maximum node-to-node distance	Maximum total wire length	Units
250	450	m

4.6 Power specifications

The sum of the steady-state power drawn by all nodes on a segment shall not exceed 36,5 W. For each branch, the sum of the products of each node's distance multiplied by that node's power shall not exceed a constant:

$$P_1 \times d_1 + P_2 \times d_2 + P_3 \times d_3 + \ldots \leq C \times \alpha \quad (1)$$

where

- C is a constant, dependent on wire type, taking into account manufacturing tolerance and all other variations except wire temperature;
- C = 1,9 x 10^3 Wm;
- P_i = Node power, i.e., the maximum steady-state power drawn by node ‘i’ from the network, in watts;
- d_i = Node distance, i.e., the distance of node ‘i’ from the link power source, in meters;
- α = 1/(1 + 0,003 93 * (temp C- 25°C)), accounting for average wire temperature.

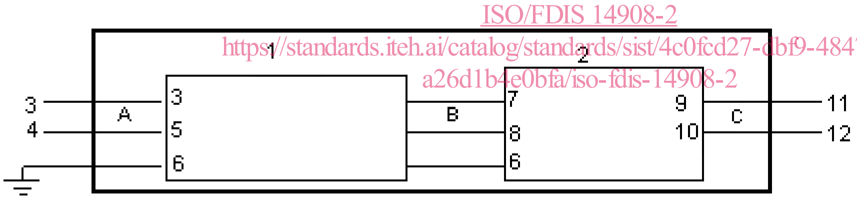
5 Link power

5.1 General

A link-powered node derives its power from the network. The power is delivered on the same two conductors that carry data.

5.2 Source

The link power source shall consist of a passive coupler together with a power supply having special attributes. The requirements for the power supply for proper system operation include its start-up behaviour, tolerance to direct shorts across its output, and output voltage regulation. A schematic for the coupler is also included. The combination coupler/power supply block diagram is shown in Figure 2. Any deviations from the power supply requirements and coupler schematic (Figure 5) are allowed provided that the link power source design is electrically equivalent.



Key

1 Power supply
2 Coupler
3 Line
4 Input
5 Neutral
6 Earth
7 Vin +
8 Vin –
9 Net +
10 Net –
11 Network
12 Output

Figure 2 — Link Power Source

The differential DC output voltage of the link power source shall be 41,0 V DC – 42,4 V DC over full operating conditions. Under normal (non-fault) conditions, the link power source shall "centre" the output voltage with respect to earth ground, resulting in +21 V and –21 V outputs at "Net+" and "Net-" respectively. The link power source shall recover after a continuous direct short across the output and shall properly restart the link powered network.

An earth reference terminal is required if the coupler is not grounded via the power supply.

5.3 Power supply requirements

Unless otherwise specified, the power supply specifications in Table 3 shall be met over all combinations of the following conditions:

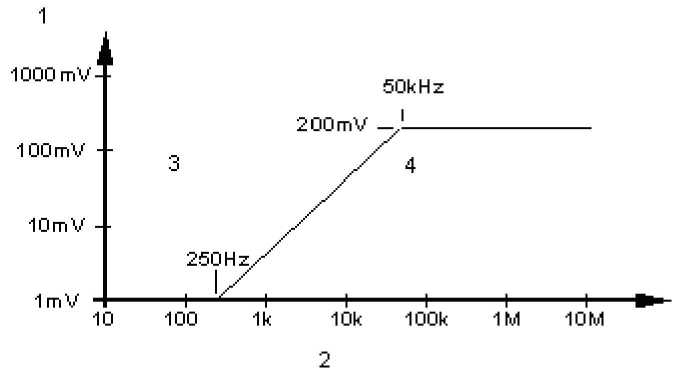
— Specified coupling circuit connected

— Line input voltage over full range per specification

— Network output load = (0 to 1,5) A D.C.

Table 3 — Power supply requirements

Description	Conditions	Specification
Line input voltage & indicator	• Measured at "A" (see Figure 2)	Line voltage as required by application environment. Input Power Applied indicator required - LED or equivalent.
Output voltage	• Measured at "B" (see Figure 2)	42,4 V DC maximum 42,08 V DC minimum
Output voltage regulation response	• Measured at "B" • 50 % step change in load	Output voltage must recover to within 1 % of its final value in less than 1ms of step change in load.
Output reference	• Measured at "B" • Coupling circuit disconnected	Floating with respect to earth.
Output ripple voltage (Differential)	• Measured at "B"	Reference Figure 2.
Spike noise (differential)	• Measured at "B" • 50 MHz bandwidth	400 mV peak-to-peak maximum.
Output common-mode noise	• Measured at "B" with respect to earth	100 mV peak-to-peak maximum.
Continuous output current capability	• Measured at "B"	0 to 1,5 A DC
Output start-up interval behaviour	• Start-up or recovery from output short circuit or over-current fault • Measured at "B"	Reference Figure 4.
Short circuit output protection	• Continuous short circuit at output for any duration	Must recover after fault is cleared according to "Output start-up interval behaviour" specification.
Single fault tolerance	• Any single component failure as open or short • Measured at "B"	"Vin+" - "Vin-" ≤ 42,4 V. |"Vin+" to earth| ≤ 42,4 V. |"Vin-" to earth| ≤ 42,4 V.



Key
1 Peak to peak ripple voltage (mV)
2 Ripple frequency (Hz)
3 Unacceptable ripple level
4 Acceptable ripple

Figure 3 — Power supply output ripple voltage requirement