Health informatics—Point-of-care medical device communication

Part 30200: Transport profile—Cable connected

Amendment 1

IEEE Engineering in Medicine and Biology Society

Sponsored by the
IEEE 11073™ Standards Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

16 September 2011

IEEE Std 11073-30200a™-2011
(Amendment to
ISO/IEEE 11073-30200:2004)

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Approved 16 June 2011

IEEE-SA Standards Board

Abstract: ISO/IEEE Std 11073-30200:2004 is extended in this amendment to include IEEE 802.3 100BASE-T and analysis of the compatibility of cable connections between ISO/IEEE Std 11073-30200:2004 and IEEE Std 802.3™-2008.

Keywords: bedside, IEEE 11073, IEEE Std 802.3-2008, Infrared Data Association (IrDA), legacy device, medical device, medical device communications, MIB, patient, SNTP

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

PDF: **ISBN 978-0-7381-6677-3** **STD97123**
Print: **ISBN 978-0-7381-6678-0** **STDPD97123**

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Introduction

This introduction is not part of IEEE Std 11073-30200a-2011, Health informatics—Point-of-care medical device communication—Part 30200: Transport profile—Cable connected—Amendment 1.

This amendment extends ISO/IEEE Std 11073-30200:2004 to include IEEE 802.3 100BASE-T, and it includes analysis of the compatibility of cable connections between ISO/IEEE Std 11073-30200:2004 and IEEE Std 802.3-2008 [B10].[a]

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[a] The numbers in brackets correspond to those of the bibliography in Annex P.

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NOTE—The editing instructions contained in this corrigendum define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strikethrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editing instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.[1]

[1] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

1. Overview

Change text as shown:

This standard is divided into 11 clauses, as follows:

- Clause 1 provides an overview of this standard.
- Clause 2 lists references to other standards that are useful in applying this standard.
- Clause 3 provides definitions and abbreviations.
- Clause 4 provides goals for this standard.
- Clause 5 provides an overview of network topology and layering.
- Clause 6 provides a profile of the physical layer.
- Clause 7 provides a profile of the data link layer.
- Clause 8 provides a profile of the network layer.
- Clause 9 provides a profile of the transport layer.
- Clause 10 describes the optional time synchronization service.
- Clause 11 provides labeling and conformance requirements.

This standard also contains ~~15~~16 annexes, as follows:

- Annex A describes the physical layer.
- Annex B provides information on the maximum cable length.
- Annex C provides examples of physical link media.
- Annex D provides example schematics for modular adapters.
- Annex E provides a detailed rationale for pin assignments.
- Annex F describes the use of IEEE 802.3 10BASE-T/100BASE-TX with this standard.
- Annex G provides a discussion of power delivery considerations.
- Annex H provides examples of simple bedside communications controller (BCC) and device communications controller (DCC) designs.
- Annex I provides an example of an isolated BCC design.
- Annex J provides an optical isolator design example.
- Annex K provides marking guidelines.
- Annex L provides protocol examples, particularly of connection establishment.
- Annex M defines the Infrared Data Association (IrDA) profile specifications adapted from the IrDA implementation guidelines.
- Annex N provides guidelines for using the SNTP time synchronization protocol.
- Annex O provides an analysis of compatibility between ISO/IEEE Std 11073-30200:2004 and 10BASE-T/100BASE-TX of IEEE Std 802.3-2008 [B10].
- Annex ~~O~~P provides bibliographical references.

3. Definitions, acronyms, and abbreviations

3.1 Definitions

Change the first paragraph and insert new footnote as shown. Delete [B2] from Annex O and renumber subsequent references in Annex O:

For the purposes of this document, the following terms and definitions apply. ~~*The Authoritative Dictionary of IEEE Standards Terms*, Seventh Edition, [B2]~~*The IEEE Standards Dictionary: Glossary of Terms & Definitions* should be consulted for terms not defined in this clause.[2]

Note that numerous definitions and abbreviations from IEEE Std 802.3–2008 [B10] are used in this document. Those definitions and abbreviations will not be repeated here. For specific information, please refer to Section One, subclause 1.4 and subclause 1.5, of IEEE Std 802.3-2008.

Change existing definitions and insert new definitions as shown:

~~3.1.1~~ 10BASE-T: IEEE Std 802.3-2008 ~~1998 Edition,~~physical layer specification for Ethernet over two pairs of unshielded twisted-pair (UTP) media at 10 Mb/s.

100BASE-TX: IEEE Std 802.3-2008 specifies operation over two copper media: two pairs of shielded twisted-pair cable (STP) and two pairs of unshielded twisted-pair cable (Category 5 UTP). For the purposes of this standard, only UTP is permitted.

~~3.1.2~~ baud: A unit of signaling speed, expressed as the number of times per second the signal can change the electrical state of the transmission line or other medium.

NOTE—Depending on the encoding strategies, a signal event may represent a single bit, more, or less, than one bit.

~~3.1.3~~ bedside communications controller (BCC): A communications controller, typically located at a patient bedside, that serves to interface between one or more medical devices. The BCC may be embedded into local display, monitoring, or control equipment. Alternatively, it may be part of a communications router to a remote hospital host computer system.

~~3.1.4~~ beginning of frame (BOF): An octet specified by infrared link access protocol (IrLAP).

~~3.1.5~~ category 5 (CAT-5) balanced cable: The designation applied to 100 ∧ unshielded twisted-pair (UTP) cables and associated connecting hardware whose transmission characteristics are specified up to 100 MHz.(ANSI/TIA/EIA-568-A-1995)

~~3.1.6~~ cyclic redundancy check (CRC): The result of a calculation carried out on the octets within an IrLAP frame; also called a frame check sequence. The CRC is appended to the transmitted frame. At the receiver, the calculation creating the CRC may be repeated, and the result compared to that encoded in the signal. *Syn:* **frame check sequence.**

~~3.1.7~~ device communications controller (DCC): A communications interface associated with a medical device. A DCC may support one or more physically distinct devices acting as a single network communications unit. Its purpose is to provide a point-to-point serial communication link to a BCC.

[2] *The IEEE Standards Dictionary: Glossary of Terms & Definitions* is available at http://standards.ieee.org.

~~3.1.8~~ **electromagnetic compatibility (EMC):** The ability of a device, equipment, or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

~~3.1.9~~ **electromagnetic interference (EMI):** Signals emanating from external sources (e.g., power supplies, transmitters) or internal sources (e.g., adjacent electronic components, energy sources) that disrupt or prevent operation of electronic systems.

~~3.1.10~~ **electrostatic discharge (ESD):** The sudden transfer of charge between bodies of differing electrostatic potentials that may produce voltages or currents that could destroy or damage electrical components.

~~3.1.11~~ **frame check sequence:** *See:* **cyclic redundancy check.**

~~3.1.12~~ **high-level data link control (HDLC):** A standard protocol defined by ISO for bit-oriented, frame delimited data communications.

~~3.1.13~~ **information access service (IAS):** A component of infrared link management protocol (IrLMP).

~~3.1.14~~ **local area network (LAN):** A communication network to interconnect a variety of intelligent devices (e.g., personal computers, workstations, printers, file storage devices) that can transmit data over a limited area, typically within a facility.

~~3.1.15~~ **medical information bus (MIB):** The informal name for the ISO/IEEE 11073 family of standards.

~~3.1.16~~ **octet:** A group of eight adjacent bits.

~~3.1.17~~ **primary station:** As defined by the infrared link access protocol (IrLAP), the station on the data link that assumes responsibility for the organization of data flow and for unrecoverable data link error conditions. It issues commands to the secondary stations and gives them permission to transmit.

~~3.1.18~~ **protocol data unit (PDU):** Information delivered as a unit between peer entities that contains control information and, optionally, data.

~~3.1.19~~ **quality of service (QoS):** The four negotiated parameters for a link: signaling speed, maximum turnaround time, data size, and disconnect threshold.

~~3.1.20~~ **radio frequency (RF): (A)** (Loosely) The frequency in the portion of the electromagnetic spectrum that is between the audio-frequency portion and the infrared portion. **(B)** A frequency useful for radio transmission.

~~3.1.21~~ **radio frequency interference (RFI):** *See:* **radio interference.**

~~3.1.22~~ **radio interference:** Degradation of the reception of a wanted signal caused by radio frequency (RF) disturbance.

~~3.1.23~~ **RJ-45: (A)** AT&T Registered Jack designation for the eight-pin modular connectors that meet the requirements of IEC 60603-7:1996 and ISO/IEC 8877:1992. **(B)** An eight-pin modular telephone plug.

~~3.1.24~~ **RS-232:** The serial interface defined in ANSI/TIA/EIA-232-F-1997.

~~3.1.25~~ **secondary station:** As defined by the infrared link access protocol (IrLAP), any station on the data link that does not assume the role of the primary station. It will initiate transmission only as a result of receiving explicit permission to do so from the primary station.

~~3.1.26~~ **service access point (SAP):** An address that identifies a user of the services of a protocol entity.

~~3.1.27~~ **service data unit (SDU):** Information that is delivered as a unit between peer service access points (SAPs). See: service access point.

~~3.1.28~~ **set normal response mode (SNRM):** A high-level data link control (HDLC) message sent by a bedside communications controller (BCC) to a device communications controller (DCC) when a successful connection to the network has occurred.

3.2 Acronyms and abbreviations

Insert the following new abbreviation in alphabetical order as shown:

NTP	network time protocol
PoC	point of care
PLL	phase-locked loop

4. Goals for this standard

Insert the following new subclause as shown:

4.1 Compliance with other standards

Devices that comply with this standard may also be required to comply with other domain- and device-specific standards that supersede the requirements of this standard and IEEE Std 802.3-2008 [B10] to which this standard refers with respect to issues including safety, reliability, and risk management. A user of this standard is expected to be familiar with all other such standards that apply and to comply with any higher specifications thus imposed. Typically, medical devices will comply with the IEC 60601-1:2005 [B6] base standards and its parts, such as IEC 60601-1-1:2000 [B7], with respect to electrical and mechanical safety and any device specific standard as might be defined in IEC 60601-1-2:2007 [B8]. Software aspects may apply through standards such as EN 62304:2005 [B5].

Devices that comply with this standard shall implement higher layers of network software as appropriate to the application. The requirements on performance of such applications and conformance are defined elsewhere and are outside the scope of this standard. Additionally, the network environment within which devices operate should be specified. Use of any medical equipment within a network environment shall be subject to risk assessment and risk management appropriate to the application and use and should adhere to standards such as ISO 14971:2007 [B11] and IEC 80001-1:2010 [B9]. The requirements of such risk assessment and risk management and conformance are outside the scope of this standard.

6. Physical layer

Insert the following text to the dashed list as shown:

—Annex F describes the use of 10BASE-T/100BASE-TX with this standard.

Annex A

(normative)

Physical layer

A.1 Overview

Change the following text as shown:

A.1.4 10BASE-T/100BASE-TX

This standard provides a measure of compatibility with high-speed communication using 10BASE-T and 100BASE-TX as defined in Section One and Section Two, respectively, of IEEE Std 802.3-2008 [B10]~~Clause 14 of IEEE Std 802.3, 1998 Edition~~.

A.4 Connector pin assignments and functions

A.4.3 Signal names and functions

Replace Table A.4 with the following table:

Table A.4—Signal names and functions

BCC connector	DCC connector	Function
bBPWR	dBPWR	Power from BCC
N/A	dDPWR	Power from DCC and sense BCC connection (+)
bGND	dGND	Signal ground
bRxD	dRxD	RS-232 data receive
bTxD	dTxD	RS-232 data transmit
bCS+	N/A	Sense DCC connection (+)
bCS–	dCS–	Connection sense (–)
bRD+	dRD+	10BASE-T/100BASE-TX receive data (+)
bRD–	dRD–	10BASE-T/100BASE-TX receive data (–)
bTD+	dTD+	10BASE-T/100BASE-TX transmit data (+)
bTD–	dTD–	10BASE-T/100BASE-TX transmit data (–)

Change the third and fourth paragraphs as shown:

This standard is compatible with a 10BASE-T/100BASE-TX interface, supported by the RD± and TD± signals (pins 1-2 and 3-6). A BCC port may be designed to support the ability to detect an ISO/IEEE 11073-30200 (RS-232) connection or a 10BASE-T/100BASE-TX connection and to communicate with either device. However, all 10BASE-T/100BASE-TX functions for BCCs and DCCs are out of the scope of this standard. Refer to Annex F for more information on the 10BASE-T/100BASE-TX interface.

A BCC can sense the connection of a DCC by testing the resistance across its bCS+ and bCS– pins. The alternative names bTD+ and bTD– indicate the 10BASE-T/100BASE-TX transmit data function.

A DCC may provide power on its dDPWR line to a line-extender or communications adapter. A DCC can sense its connection to a BCC by testing the resistance between its dDPWR and dCS– pins. The alternative names dTD+ and dTD– indicate the 10BASE-T transmit data function.

A.4.4 BCC pin assignments and functions

Change the third paragraph as shown:

The bRD± pins of the BCC shall be shorted together or terminated with R < 110 • (R = 100 • preferred) to allow a DCC to detect its connection to the BCC. A BCC port with 10BASE-T/100BASE-TX capability automatically satisfies this requirement due to the low dc resistance (< 0.5 •) of the bRD± input transformer windings.

A.4.5 DCC pin assignments and functions

Change the third and fourth paragraphs as shown:

The dRD± pins of the DCC shall be shorted together or terminated with R < 110 Ω (R = 100 Ω preferred) to allow a BCC to detect its connection to the DCC. The short or termination shall not be electrically connected to any other internal DCC circuitry (i.e., there is no dc path to ground). A DCC with 10BASE-T/100BASE-TX capability automatically satisfies this requirement due to the low dc resistance (< 0.5 Ω) of the dRD± input transformer windings.

A DCC may provide circuitry to sense its connection to a BCC by testing the dc resistance between its dDPWR and dCS– pins. For a DCC that provides power on its dDPWR pin, the connection sense circuit should tolerate or detect the reduced voltage on the dDPWR line due to a line extender or adapter that uses more current than dDPWR can provide. Alternatively, a DCC that provides the zero-power option (and does not have 10BASE-T/100BASE-TX capability) may tie dDPWR to dGND and apply a test current to its dCS– pin.

Annex E

(informative)

Detailed rationale for pin assignments

Change Annex E as shown:

This annex provides a detailed rationale for the pin assignments provided in Annex A.

Pins 1, 2, 3, and 6 conform to 10BASE-T/100BASE-TX pin assignments. These pin assignments allow for direct connection of 10BASE-T/100BASE-TX devices and other equipment in an architecturally consistent manner. A BCC could be designed to support either an ISO/IEEE 11073-30200:2004 (RS-232) connection or a 10BASE-T/100BASE-TX connection.

Using a cross-pinned host/hub connector allows straight-through cables to be used. Straight-through cables are much easier to use in a clinical environment. The use of straight-through cables conforms to industry practice for off-the-shelf 10BASE-T/100BASE-TX hubs, which, incidentally, could be used with the proposed MIB connector pinout if only 10BASE-T/100BASE-TX functionality is required.

Pins 4 and 5 conform to ANSI/TIA/EIA-561-1990 pin assignments for Signal_Common and Received_Data. Assigning these signals to a twisted pair improves signal integrity favoring the data transfer direction that will be most frequently used (i.e., from DCC to BCC).

Assigning bTxD and bBPWR to pins 7 and 8, respectively, provides signal integrity benefits similar to pairing pins 4 and 5 (i.e., bBPWR serves as an ac return for bTxD).

Pairing bGND and bRxD to pins 4 and 5 and bTxD and bBPWR to pins 7 and 8 provides excellent device (DCC) survivability if a cross-connected cable is inadvertently used to connect the BCC and DCC. Also, locating dGND and dDPWR on pins 4 and 8, respectively, allows the DCC internal dGND and dDPWR circuit board traces to fully encircle the components (in the case of small single-layer board inside a modular adapter).

For a BCC capable of 10BASE-T/100BASE-TX and unpowered DCC detection, the bTD± 10BASE-T/100BASE-TX pair is used because any differential capacitance introduced by the detection circuit is tolerated better at the 10BASE-T/100BASE-TX transmitter than at the receiver. Any differential capacitance at the input windings of the receiver transformer would significantly reduce the overall common-mode rejection of the 10BASE-T receiver whereas it would have relatively little impact on the 10BASE-T/100BASE-TX transmitter.

Annex F

(informative)

Change Annex F as shown:

10BASE-T/100BASE-TX of IEEE Std 802.3-2008

Figure F.1 shows an example use of a 10BASE-T/100BASE-TX interface, using the two line pairs 1-2 and 3-6. The 10BASE-T and 100BASE-TX interfaces ~~is~~ are specified in ~~Clause 14 of IEEE Std 802.3, 1998 Edition~~ Section One and Section Two, respectively, of IEEE Std 802.3-2008 [B10].

High-speed data communications is possible using a 10BASE-T/100BASE-TX interface. This standard does not prevent an ISO/IEEE 11073-30200 BCC port from also being used as a 10BASE-T/100BASE-TX interface. However, the 10BASE-T/100BASE-TX standard is out of scope for this standard.

~~NOTES~~

NOTE 1—Detection of an unpowered DCC or BCC is still possible when 10BASE-T/100BASE-TX is used, but more complex circuitry is required.

NOTE 2—This standard is not compatible with IEEE 802.3 standards that use all four twisted pairs, such as 100BASE-4.

Insert Annex O as shown:

Annex O

(informative)

Analysis of compatibility between ISO/IEEE Std 11073-30200:2004 and 10BASE-T/100BASE-TX of IEEE Std 802.3-2008

O.1 General

The power over Ethernet functionality of IEEE Std 802.3-2008 [B10] is deemed not compatible with ISO/IEEE Std 11073-30200:2004 and shall not be used in the Point of Care Medical Device Communications environment. The Power over Ethernet functionality of IEEE Std 802.3-2008 is not supported in this standard.

This annex provides an analysis of the outcome should an ISO/IEEE 11073-30200 interface be connected to a Power over Ethernet interface.

NOTE—Although the Power over Ethernet functionality of alternative A of IEEE Std 802.3-2008 [B10] can be pin compatible with ISO/IEEE Std 11073-30200:2004, it is not included due to the following issues:

— Patient electrical safety considerations (IEC 60601 series and others) with respect to the 44 V dc to 57 V dc Power over Ethernet supply voltage.
— Concern over managing two different, noninteroperable power schemes in the Point of Care environment (i.e., the existing ISO/IEEE 11073-30200 powering [also known as MIB powering] plus the addition of Power over Ethernet powering).
— The Power over Ethernet functionality of alternative B of IEEE Std 802.3-2008 [B10] is not compatible with ISO/IEEE Std 11073-30200:2004.
— The potential for connecting incompatible devices.

O.2 Overview

The analysis in this annex deals with the result of attempted interconnection between devices taken from the following two standards:

— ISO/IEEE Std 11073-30200:2004
— IEEE Std 802.3-2008 [B10]

Each of the preceding standards uses the RJ-45 connector. Each of these interfaces has a signaling component and a powering component.

O.2.1 Basic pin outs

Both IEEE Std 802.3-2008 [B10] and ISO/IEEE Std 11073-30200:2004 use the RJ-45 connector as depicted in Figure O.1 for connection between devices. For comparative reference, the pin outs of both standards are given in Table O.1. The description of correct use appears in the subsequent clauses.

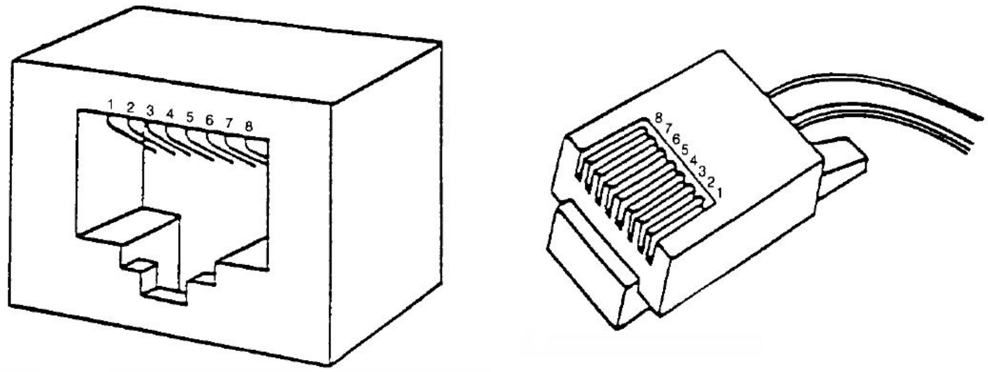


Figure O.1—RJ-45 Connector diagrams

Table O.1—Basic pin outs

IEEE Std 802.3-2008 (aka Ethernet)						ISO/IEEE Std 11073-30200:2004			
Signaling			w/ Power over Ethernet						
10 BaseT and 100 Base-TX	1000 BaseT	Conductor	Power Sourcing Eqpt: Alt A (MDI)	Power Sourcing Eqpt: Alt A (MDI-x)	Power Sourcing Eqpt: Alt B	Bedside Comm. Controller (BCC)	Pin and signal direction	Device Comm. Controller (DCC)	Function
TD+	Pair A+	1	V+	V–		bRD+	1 <-	dDPWR/ dTD+	DPWR/10Base-T
TD–	Pair A–	2	V+	V–		bRD–	2 <-	dCS–/ dTD–	BCC sense/10Base-T
RD+$^+$	Pair B+	3	V–	V+		bCS+/ bTD+	3 ->	dRD+	DCC sense/10Base-T
<nc>	Pair C+	4			V+	bGND	4 <>	dGND	Signal Ground
<nc>	Pair C–	5			V+	bRxD	5 <-	dTxD	RS-232
RD–	Pair B–	6	V–	V+		bCS–/ bTD–	6 ->	dRD–	DCC sense/10Base-T
<nc>	Pair D+	7			V–	bTxD	7 ->	dRxD	RS-232
<nc>	Pair D–	8			V–	bBPWR	8 ->	dBPWR	BPWR

O.2.2 ISO/IEEE 11073-30200 PoC cable connected interface

ISO/IEEE Std 11073-30200:2004 contains both a signaling component and a powering component. The signaling component is based on ANSI/TIA/EIA-232-F-1997 (commonly referred to as RS-232). In the ISO/IEEE Std 11073-30200:2004 context, the RS-232 based signaling provides a full-duplex, short-haul, asynchronous serial binary data interchange at data rates of at least 9600 bps and optionally higher. It uses only RS-232 transmit (TxD) and receive (RxD) lines without RS-232 handshake lines.

ISO/IEEE Std 11073-30200:2004 provides two separate power sourcing options as follows:

— BCC supplying power toward a DCC. (This was envisioned as a method for a BCC to power the clinical functionality in a DCC.) The BCC, if it supplies power, can supply up to 100 mA @ +5VDC on RJ-45, pin 8.

— DCC supplying power toward a BCC. (This was envisioned as a way for a DCC, powered by some other mechanism, to supply power to a line/interface extender/converter). The DCC, if it supplies power, can supply up to 100 mA @ +5VDC on RJ-45, pin 1.

These are shown in Figure O.2.

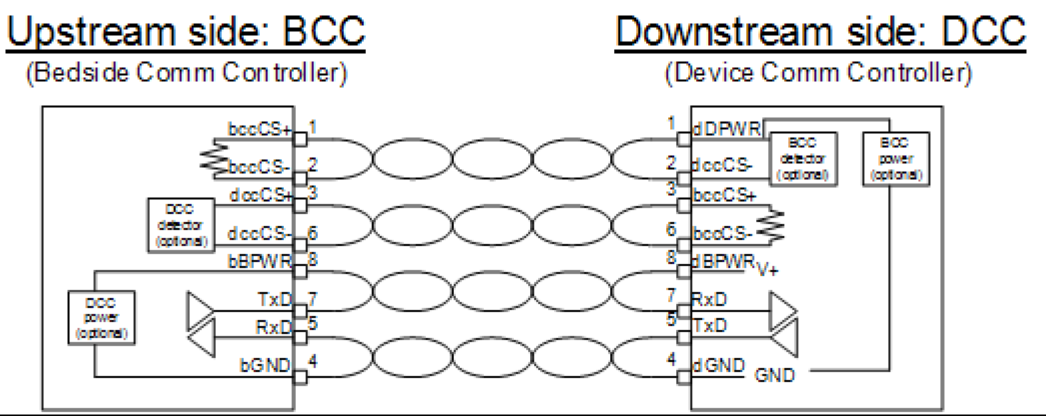


Figure O.2—Intended use: ISO/IEEE 11073-30200:2004

O.2.3 IEEE 802.3 10BASE-T/100BASE-TX interface

IEEE Std 802.3-2008 [B10] contains both a signaling component and a powering component. The full standard has numerous options for the signaling component, including 10 Mbps over coaxial cable to 10 Gbps over fiber cable. For the purposes of ISO/IEEE Std 11073-30200:2004, consideration is restricted to the 10BASE-T and 100BASE-TX specification of IEEE Std 802.3-2008. These use the "first" two pairs, pair 1/2 and pair 3/6, of the Category 5 (or better) unshielded, twisted pair cabling. Specifically, the compatible Ethernet signaling options are 10BASE-T and 100BASE-TX. There are pin compatible with ISO/IEEE Std 11073-30200:2004.

The IEEE 802.3 PoE features are described in Section Two, Clause 33, of IEEE Std 802.3-2008 [B10], with supporting informative Annexes 33A through 33E.

Power over Ethernet has two alternatives, i.e., A and B, as follows:

— Alternative A requires the use of center tapped Ethernet signaling transformers to provide DC power over the "first" two Category 5 pairs: pair 1/2 and pair 3/6.

— Alternative B separately uses the "second" two Category 5 pairs, pair 4/5 and pair 7/8, to provide DC power. Alternative B is used to provide midspan powering.

The three alternatives of 10BASE-T and 100BASE-TX of IEEE Std 802.3-2008 [B10] are shown in Figure O.3 through Figure O.5.

O.2.3.1 Intended use: Ethernet

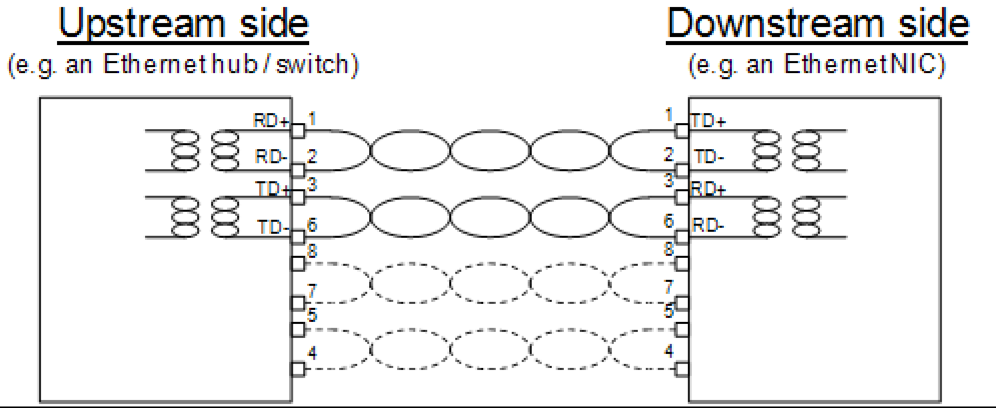


Figure O.3—Intended use: Ethernet

O.2.3.2 Intended use: Power over Ethernet, alternative A

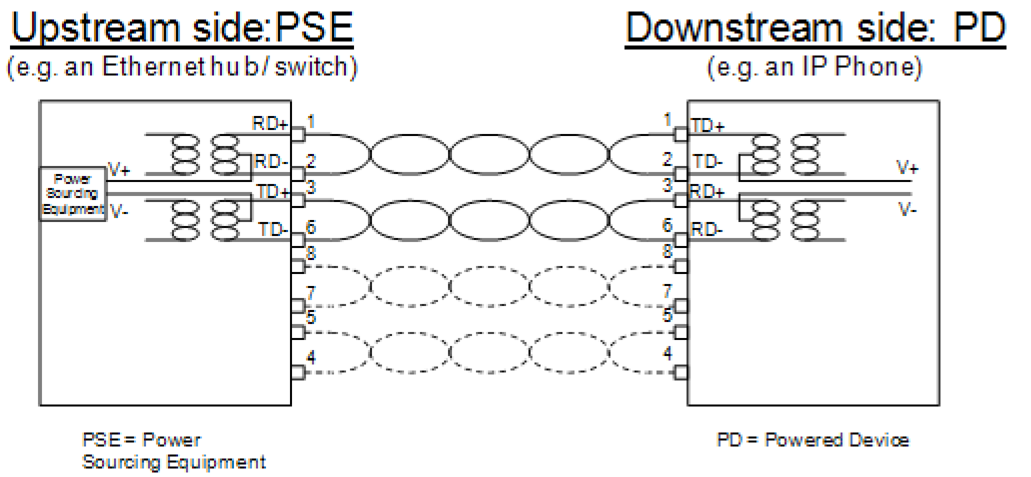


Figure O.4—Intended use: Power over Ethernet, alternative A

O.2.3.3 Intended use: Power over Ethernet, alternative B

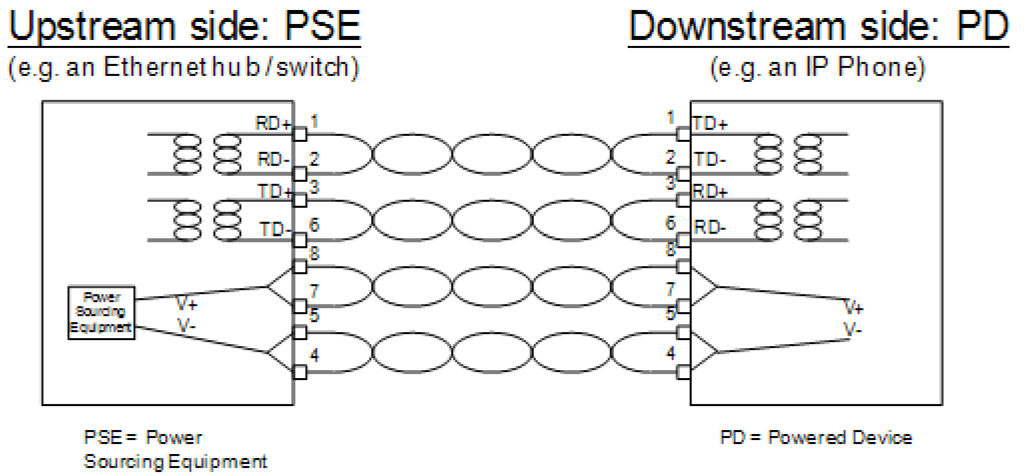
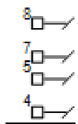
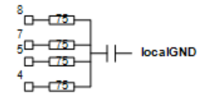
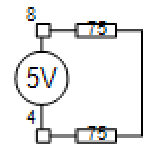
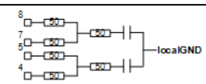
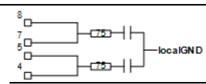
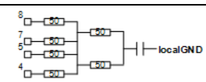
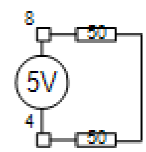
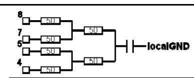
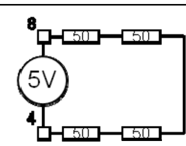
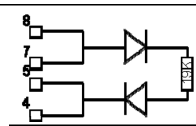
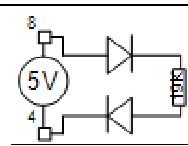
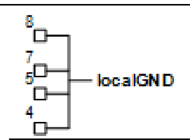
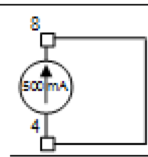


Figure O.5—Intended use: Power over Ethernet, alternative B

O.2.4 Sample Ethernet terminations

In performing the ISO/IEEE 11073-30200 and Ethernet miscabling analysis, several different Ethernet termination networks were found to be in use. Table O. gives the specific termination network, analyzes the equivalent impedances, and provides the details of each analysis.

Table O.2—Sample Ethernet terminations

Termination	Implementation	Equivalent circuit of worst-case condition	Source(s)	Analysis of worst-case condition
T1		Open	Common “nonterminated” option	No DC path No smoke possibility
T2			Found “in the wild” in Cisco (quake-2fe)	$I = V/R$ = 5 V/150 Ω = 33.3 mA $P_{res} = I^2 \times R = (33.3\ \text{mA})^2 \times 75\ \Omega$ = 83 mW Conclusion: resistors with a body size of: 0402 & smaller: damage potential (1) 0603 & larger: benign
T3		No DC path	LXT971A data sheet (http://www.datasheetarchive.com/pdf/2067847.pdf, pp. 49–50)	No DC path No smoke possibility
T4		No DC path	Found “in the wild” in Cisco (quake-2fe)	No DC path No smoke possibility
T5			Level1/Intel LDB901 demo board schematic (http://www.intel.com/design/network/products/LAN/manuals/24910201.pdf, p. 15)	$I = V/R$ = 5 V/100Ω = 50 mA $P_{res} = I^2 \times R = (50\ \text{mA})^2 \times 50\ \Omega$ = 125 mW Conclusion: resistors with a body size of: 0805 & smaller: damage potential (1) 1206 & larger: benign
T6			LXT972A data sheet (http://www.ortodoxism.ro/datasheets/Intel/mXuyqz.pdf, pp. 41–42)	$I = V/R$ = 5 V/200 Ω = 25 mA $P_{res} = I^2 \times R = (25\ \text{mA})^2 \times 50\ \Omega$ = 32 mW Conclusion: resistors with a body size of: 0201 & larger: benign (1)
T7			IEEE 802.3 Power over Ethernet detection mode (Clause 33 of IEEE Std 802.3-2008 [B10])	$I = V/R$ = 5 V/19 kΩ = 263 µA $P_{res} = I^2 \times R = (263\ \mu\text{A})^2 \times 19\ \text{k}\Omega$ = 1.32 mW Conclusion: resistors with a body size of: 0201 & larger: benign (1)
T8			LXT915 data sheet (http://www.ortodoxism.ro/datasheets/lvl1/LXT915.pdf, p. 14) Note: fails IEEE 802.3 isolation requirement.	I = 500 mA Analysis: even assuming internal tracks **and** the thin copper plating (1/2 oz) **and** thin traces (20 mil) **and** a standard 20 °C temperature rise the trace can still carry 500 mA. (2) Conclusion: <20 mil: damage potential; ≥ 20 mil: benign.

NOTE 1—Surface mount resistor maximum power dissipation
0201—50 mW 0402—63 mW 0603—100 mW 0805—125 mW 1206—250 mW

NOTE 2—PCB trace current capacity:
http://interfacebus.blogspot.com/2006/03/pwb-internal-trace-i-capacity.html
http://www.interfacebus.com/PWB_External_Trace_Capacity.html
http://www.circuitboards.com/capacity.php3

O.3 Analysis of compatibility of ISO/IEEE Std 11073-30200:2004 and 10BASE-T/100BASE-TX of IEEE Std 802.3-2008

O.3.1 Analysis conclusion

Power over Ethernet, alternative A, is functionality compatible with the pin out, signaling, and powering definitions of ISO/IEEE Std 11073-30200:2004.

Power over Ethernet, alternative B, is incompatible with the pin out, signaling, and powering definitions of ISO/IEEE Std 11073-30200:2004.

A summary of the analysis is given in Table O.3 in O.3.2, and a full analysis of all the scenarios is given in O.3.3.

O.3.2 Analysis summary

Table O.3—Analysis summary

Scenario group	**Scenario**	**Upstream**	**Downstream**	**Conclusion**
		DCC "straight" cabled to an Ethernet wall receptacle		
A	1	Standard Ethernet	DCC	Nonoperational, benign
	2	Power over Ethernet, alt A	DCC	Nonoperational, benign
	3	Power over Ethernet, alt B	**DCC**	Nonoperational, **damage potential: 3 conditions**
		BCC "straight" cabled to an Ethernet wall receptacle		
B	4	**Standard Ethernet**	BCC	Nonoperational, **damage potential: 3 conditions**
	5	**Power over Ethernet, alt A**	BCC	Nonoperational, **damage potential: 3 conditions**
	6	Power over Ethernet, alt B	**BCC**	Nonoperational, **damage potential: 4 conditions**
		BCC "straight" cabled to an Ethernet device		
C	7	BCC	**Standard Ethernet**	Nonoperational, **damage potential: 3 conditions**
	8	BCC	**Power over Ethernet, alt A**	Nonoperational, **damage potential: 3 conditions**
	9	**BCC**	Power over Ethernet, alt B	Nonoperational, **damage potential: 4 conditions**
		DCC "straight" cabled to an Ethernet device		
D	10	DCC	Standard Ethernet	Nonoperational, benign
	11	DCC	Power over Ethernet, alt A	Nonoperational, benign
	12	**DCC**	Power over Ethernet, alt B	Nonoperational, **damage potential: 3 conditions**

Scenario group	Scenario	Upstream	Downstream	Conclusion
DCC "cross-over" cabled to an Ethernet wall receptacle				
E	13	Standard Ethernet	DCC	Nonoperational, benign
	14	Power over Ethernet, alt A	DCC	Nonoperational, benign
	15	Power over Ethernet, alt B	DCC	Nonoperational, damage potential: 4 conditions
BCC "cross-over" cabled to an Ethernet wall receptacle				
F	16	Standard Ethernet	BCC	Nonoperational, damage potential: 4 conditions
	17	Power over Ethernet, alt A	BCC	Nonoperational, damage potential: 4 conditions
	18	Power over Ethernet, alt B	BCC	Nonoperational, damage potential: 5 conditions
BCC "cross-over" cabled to an Ethernet device				
G	19	BCC	Standard Ethernet	Nonoperational, damage potential: 4 conditions
	20	BCC	Power over Ethernet, alt A	Nonoperational, damage potential: 4 conditions
	21	BCC	Power over Ethernet, alt B	Nonoperational, damage potential: 5 conditions
DCC "cross-over" cabled to an Ethernet device				
H	22	DCC	Standard Ethernet	Nonoperational, benign
	23	DCC	Power over Ethernet, alt A	Nonoperational, benign
	24	DCC	Power over Ethernet, alt B	Nonoperational, damage potential: 4 conditions

O.3.3 Analysis details

O.3.3.1 Scenario 1

Scenario Group A: DCC "straight" cabled to an Ethernet wall receptacle.

Scenario 1: Upstream—Standard Ethernet/downstream—30200: DCC

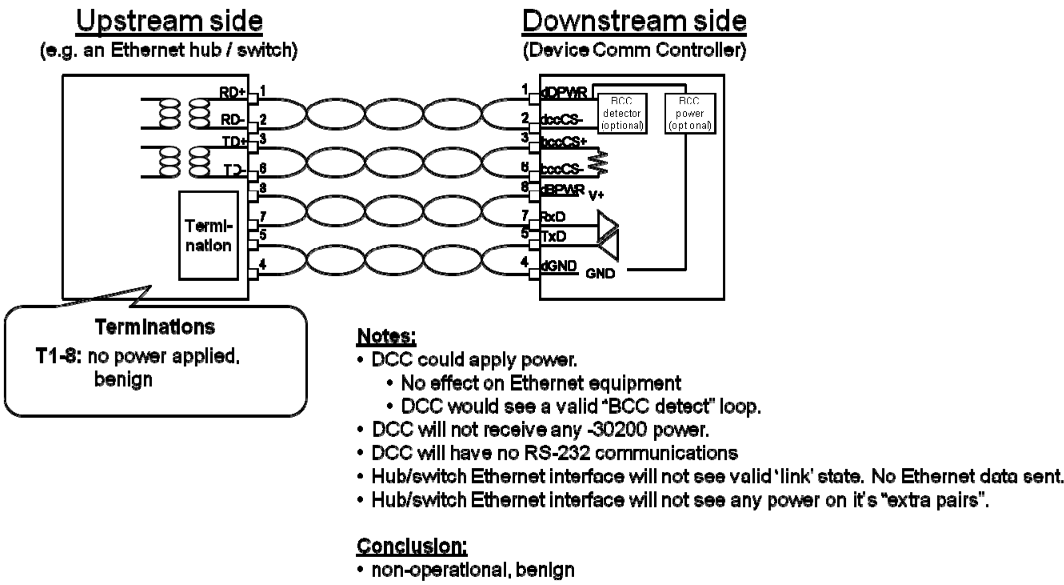


Figure O.6—Scenario 1: Upstream—Standard Ethernet/downstream—30200: DCC

O.3.3.2 Scenario 2

Scenario Group A: DCC "straight" cabled to an Ethernet wall receptacle.

Scenario 2: Upstream—PoE: alternative A/downstream—30200: DCC

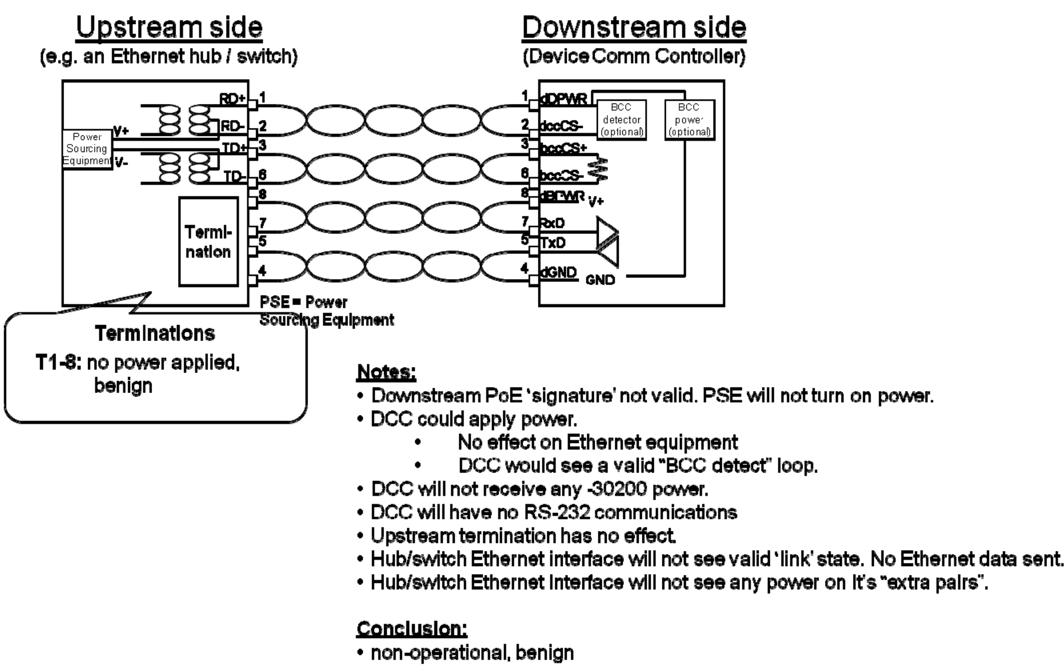


Figure O.7—Scenario 2: Upstream—PoE: alternative A/downstream—30200: DCC

O.3.3.3 Scenario 3

Scenario Group A: DCC "straight" cabled to an Ethernet wall receptacle.

Scenario 3: Upstream—PoE: alternative B/downstream—30200: DCC

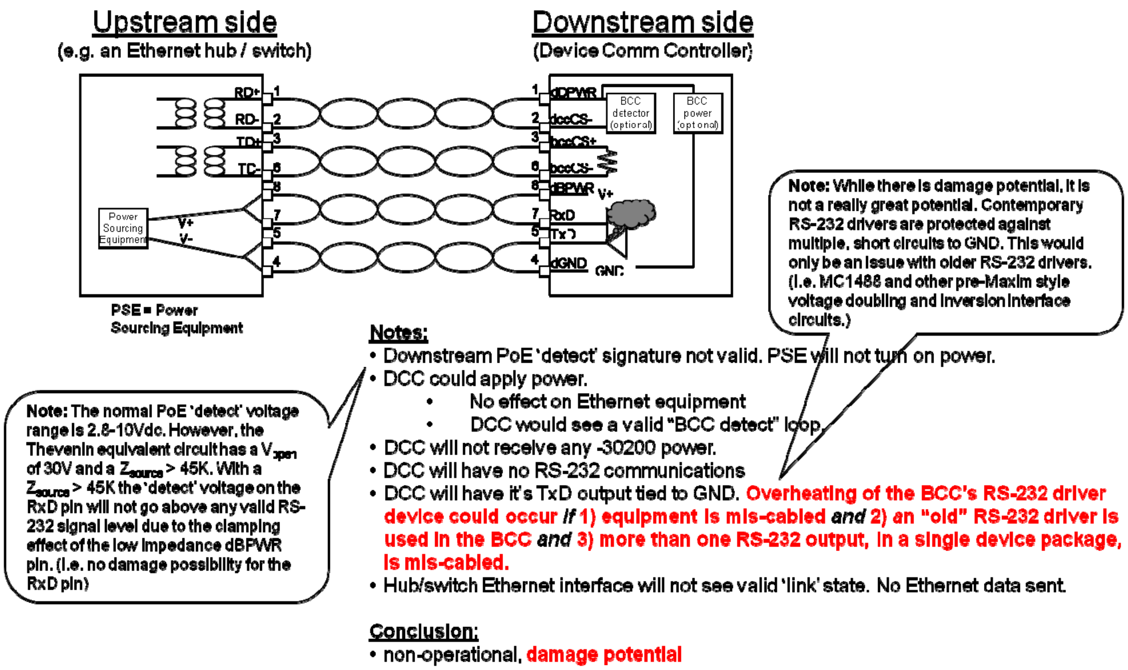


Figure O.8—Scenario 3: Upstream—PoE: alternative B/downstream—30200: DCC

O.3.3.4 Scenario 4

Scenario Group B: BCC "straight" cabled to an Ethernet wall receptacle.

Scenario 4: Upstream—Standard Ethernet/downstream—30200: BCC

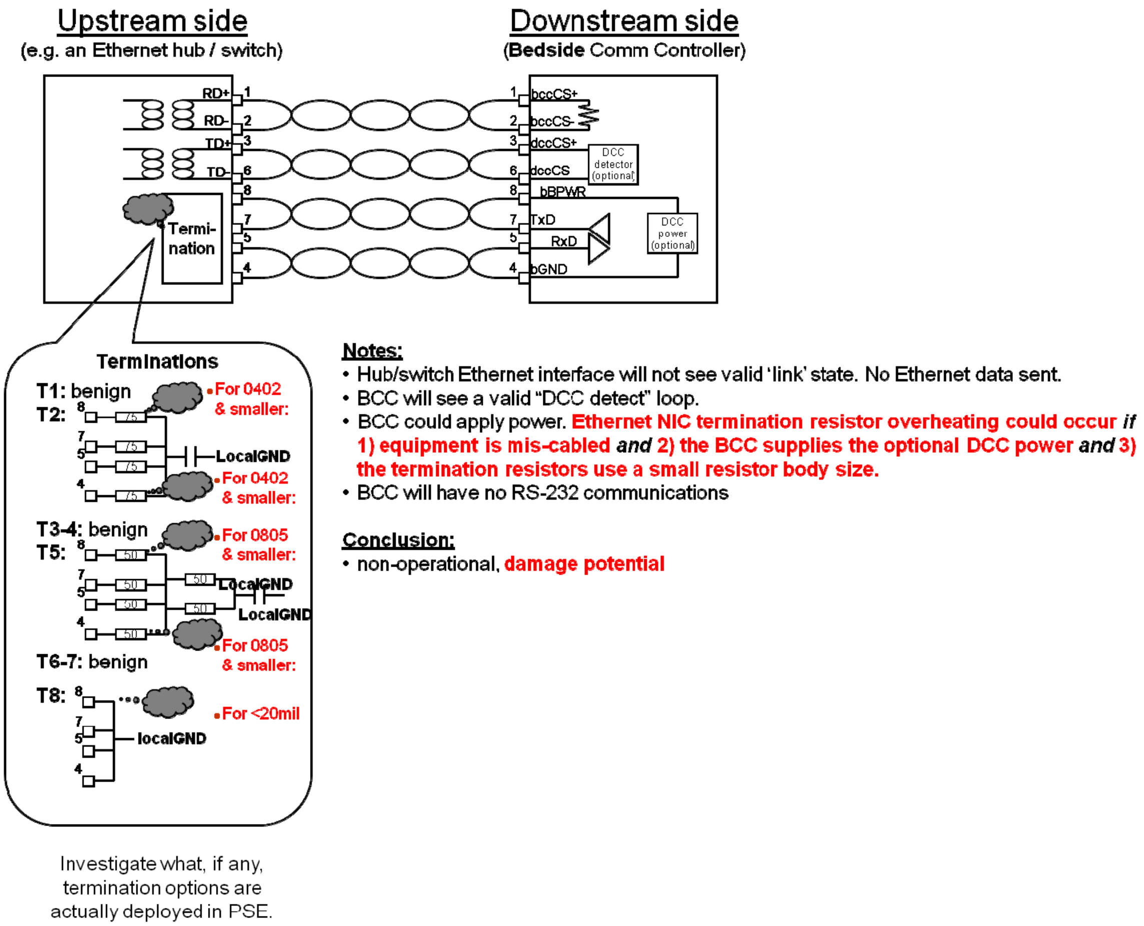


Figure O.9—Scenario 4: Upstream—Standard Ethernet/downstream—30200: BCC

O.3.3.5 Scenario 5

Scenario Group B: BCC "straight" cabled to an Ethernet wall receptacle.

Scenario 5: Upstream—PoE: alternative A/downstream—30200: BCC

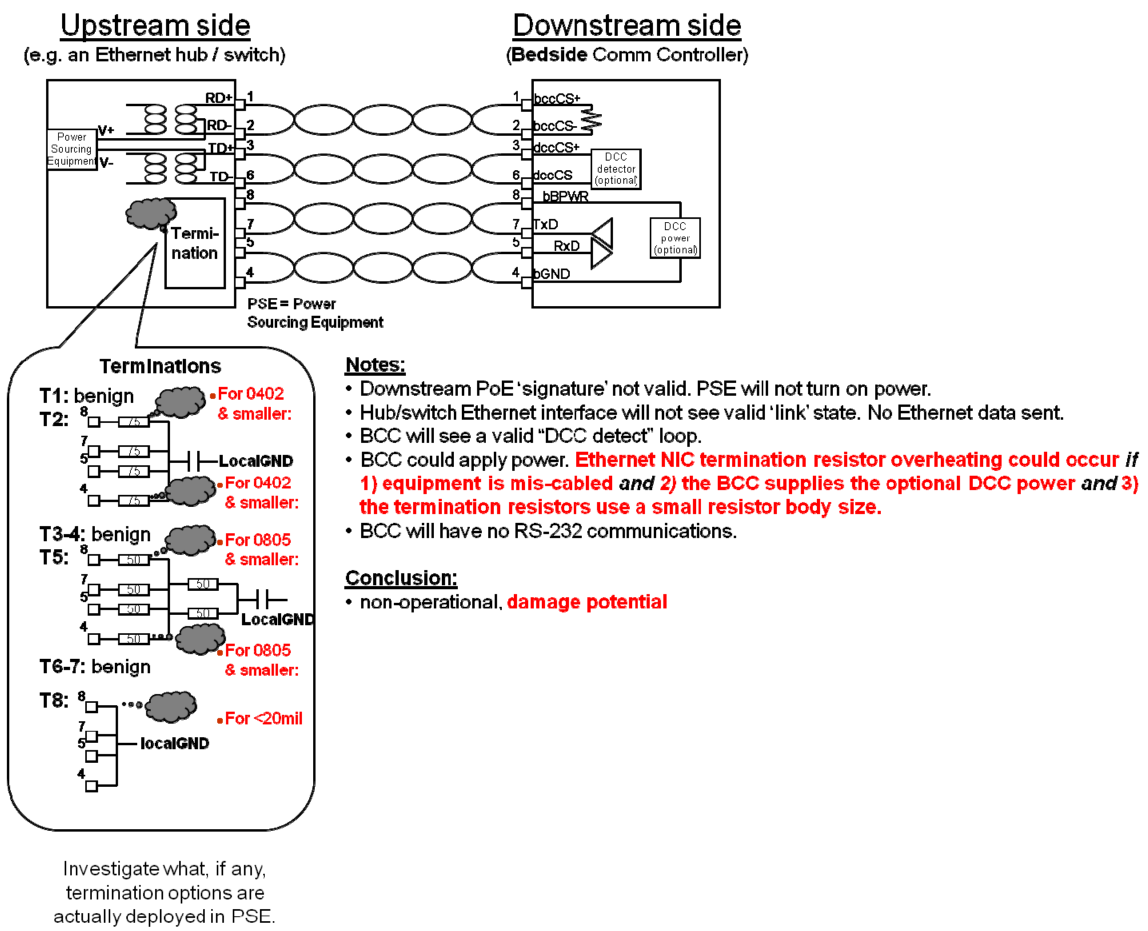


Figure O.10—Scenario 5: Upstream—PoE: alternative A/downstream—30200: BCC

O.3.3.6 Scenario 6

Scenario Group B: BCC "straight" cabled to an Ethernet wall receptacle.

Scenario 6: Upstream—PoE: alternative B/downstream—30200: BCC

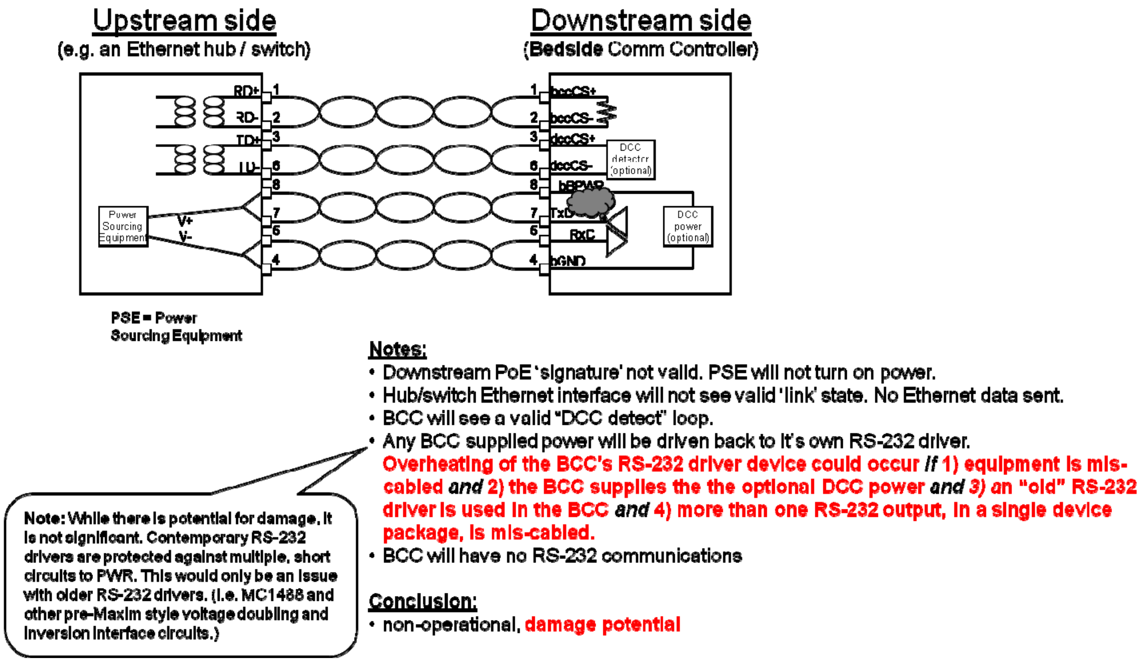


Figure O.11—Scenario 6: Upstream—PoE: alternative B/downstream—30200: BCC

O.3.3.7 Scenario 7

Scenario Group C: BCC "straight" cabled to an Ethernet device.

Scenario 7: Upstream–30200: BCC/downstream—Standard Ethernet

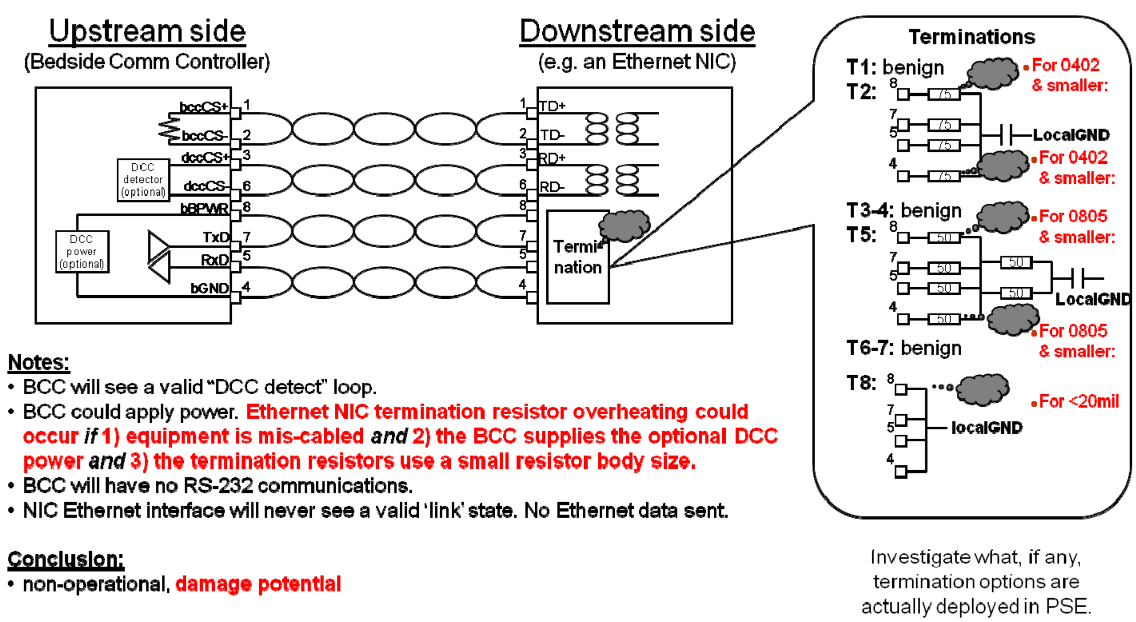


Figure O.12—Scenario 7: Upstream—30200: BCC/downstream—Standard Ethernet

O.3.3.8 Scenario 8

Scenario Group C: BCC “straight” cabled to an Ethernet device.

Scenario 8: Upstream—30200: BCC/downstream—PoE: alternative A

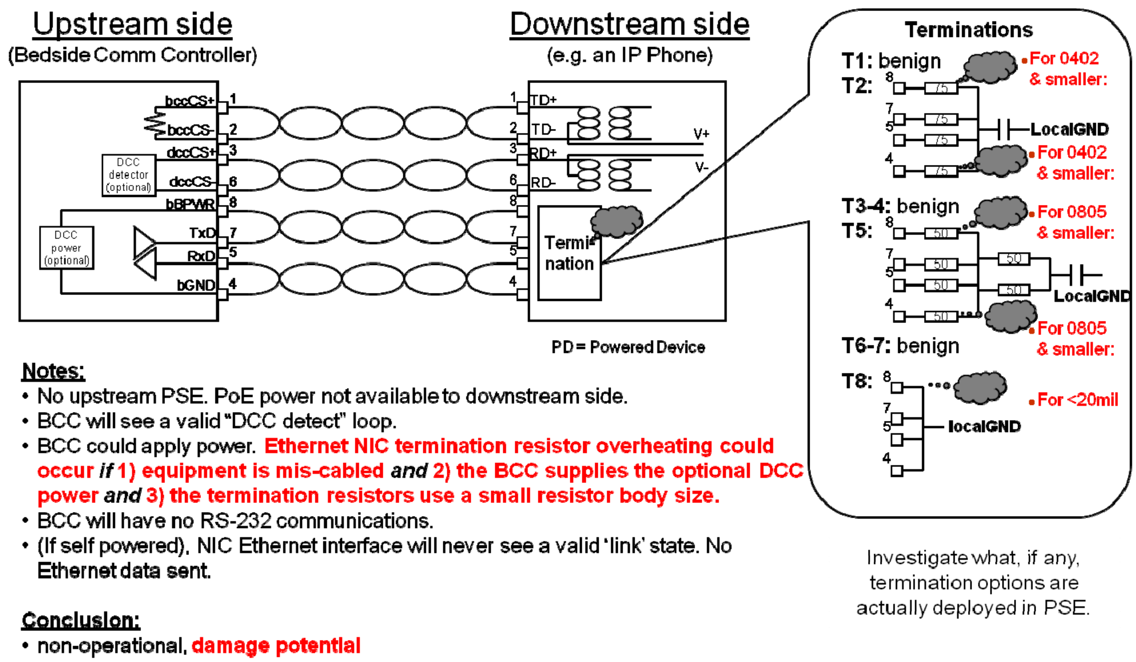


Figure O.13—Scenario 8: Upstream—30200: BCC/downstream—PoE: alternative A

O.3.3.9 Scenario 9

Scenario Group C: BCC “straight” cabled to an Ethernet device.

Scenario 9: Upstream—30200: BCC /downstream—PoE: alternative B

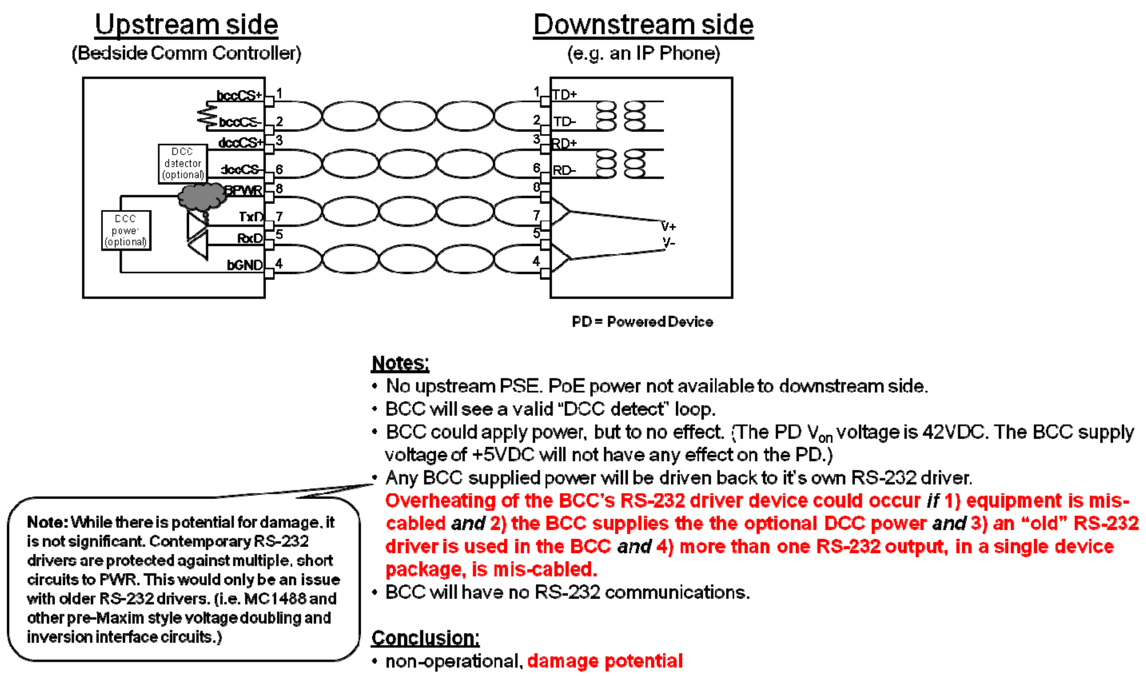


Figure O.14—Scenario 9: Upstream—30200: BCC/downstream—PoE: alternative B

O.3.3.10 Scenario 10

Scenario Group D: DCC "straight" cabled to an Ethernet device.

Scenario 10: Upstream—30200: DCC/downstream—Standard Ethernet

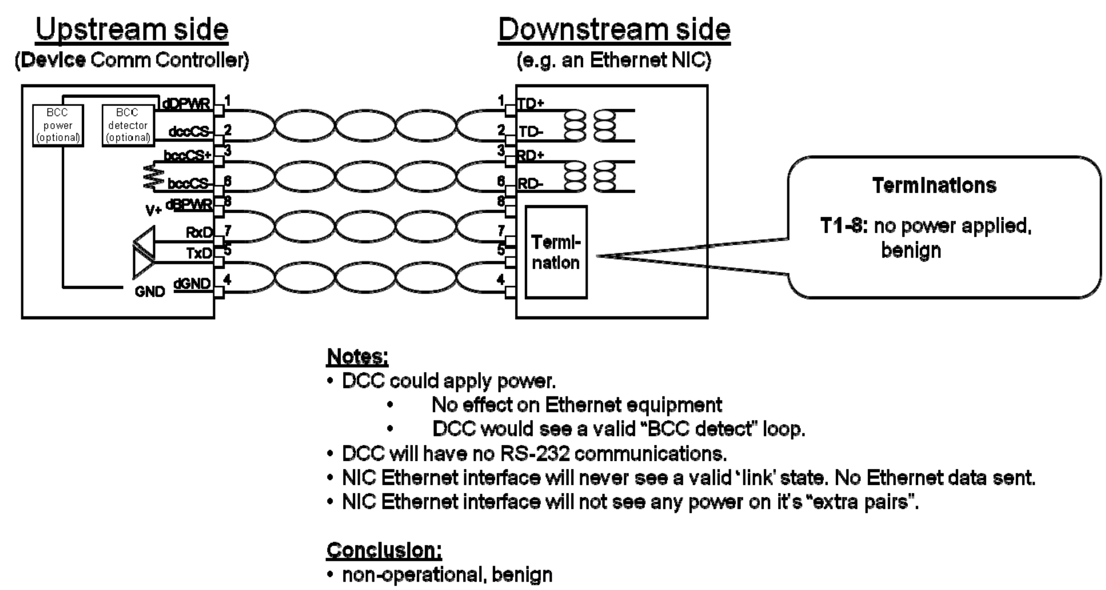
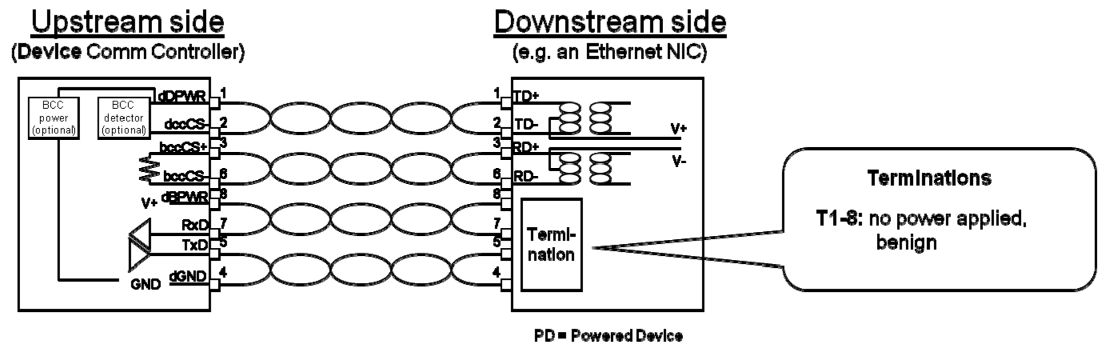


Figure O.15—Scenario 10: Upstream—30200: DCC/downstream—Standard Ethernet

O.3.3.11 Scenario 11

Scenario Group D: DCC "straight" cabled to an Ethernet device

Scenario 11: Upstream—30200: DCC /downstream—PoE: alternative A



Notes:
- DCC could apply power.
  - No effect on Ethernet equipment
  - DCC would see a valid "BCC detect" loop.
- DCC will have no RS-232 communications.
- NIC will never receive PoE power.
- NIC Ethernet interface will never see a valid 'link' state. No Ethernet data sent.
- NIC Ethernet interface will not see any power on it's "extra pairs".

Conclusion:
- non-operational, benign

Figure O.16—Scenario 11: Upstream—30200: DCC/downstream—PoE: alternative A

O.3.3.12 Scenario 12

Scenario Group D: DCC "straight" cabled to an Ethernet device.

Scenario 12: Upstream—30200: DCC/downstream—PoE: alternative B

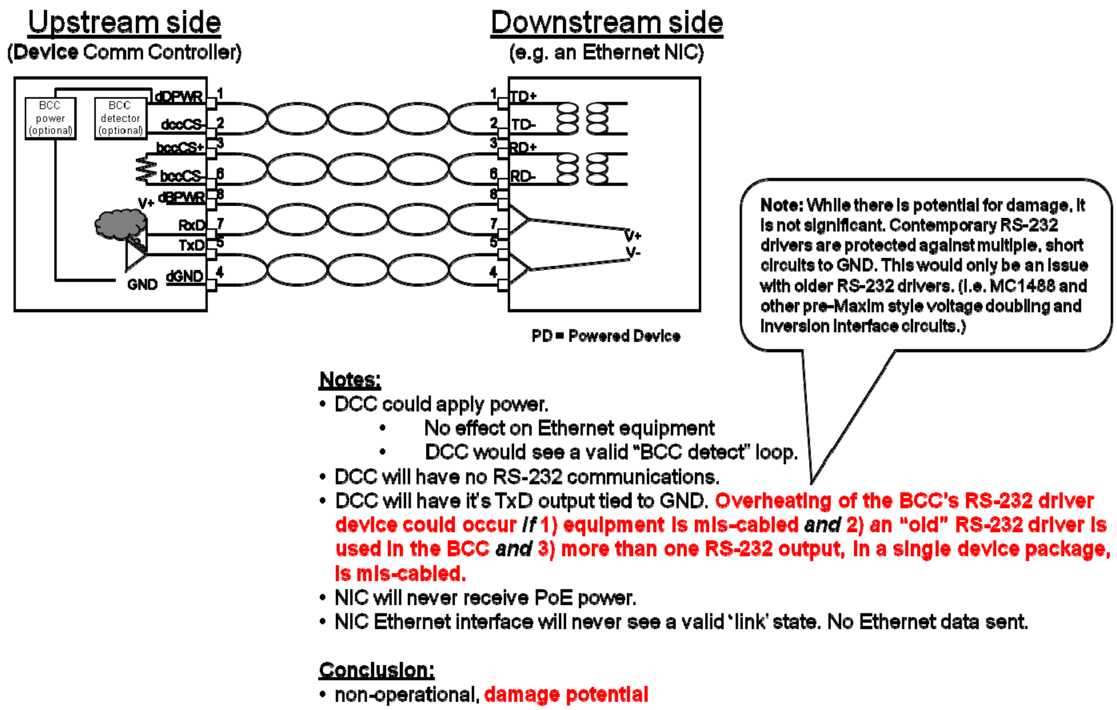


Figure O.17—Scenario 12: Upstream—30200: DCC/downstream—PoE: alternative B

O.3.3.13 Scenario 13

Scenario Group E: DCC "cross-over" cabled to an Ethernet wall receptacle.

Scenario 13: Upstream—standard Ethernet/downstream—30200: DCC

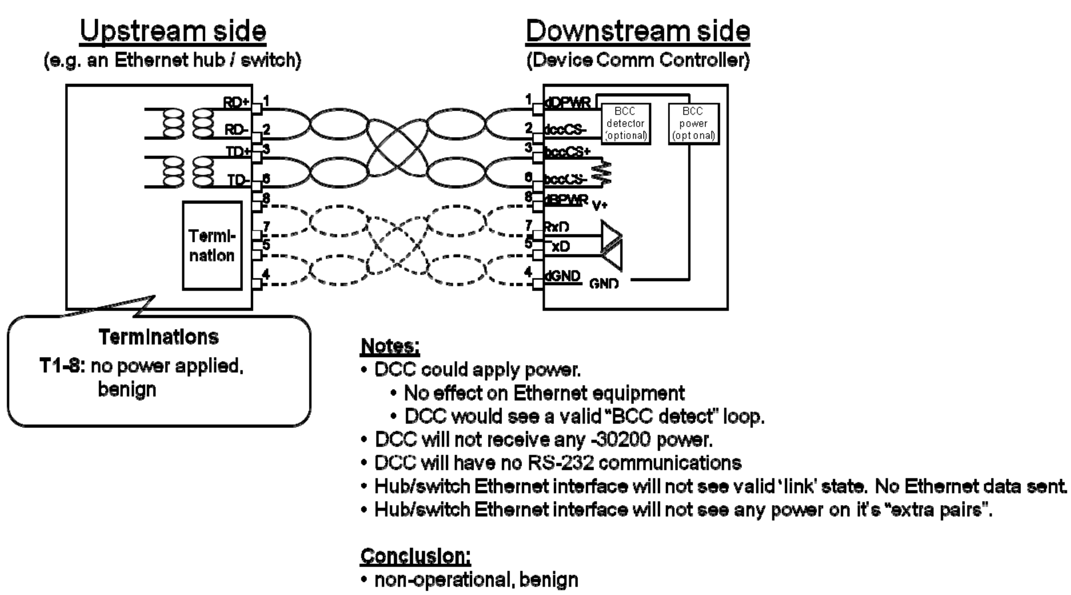


Figure O.18—Scenario 13: Upstream—Standard Ethernet/downstream—30200: DCC

O.3.3.14 Scenario 14

Scenario Group E: DCC "cross-over" cabled to an Ethernet wall receptacle.

Scenario 14: Upstream—PoE: alternative A /downstream—30200: DCC

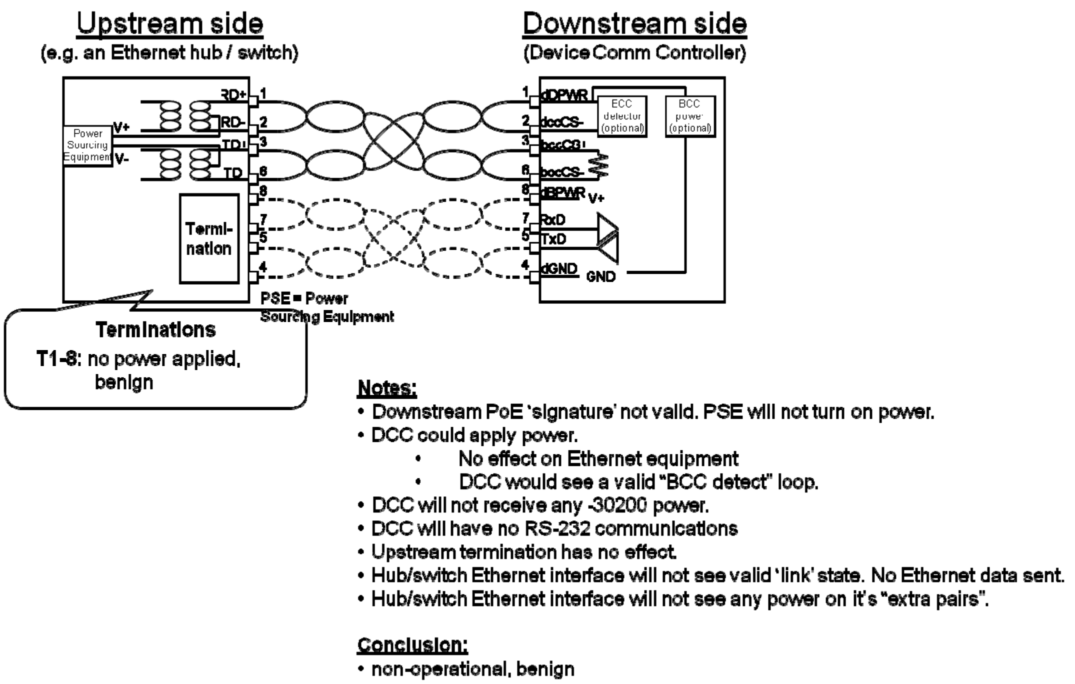


Figure O.19—Scenario 14: Upstream—PoE: alternative A/downstream—30200: DCC

O.3.3.15 Scenario 15

Scenario Group E: DCC "cross-over" cabled to an Ethernet wall receptacle.

Scenario 15: Upstream—PoE: alternative B/downstream—30200: DCC

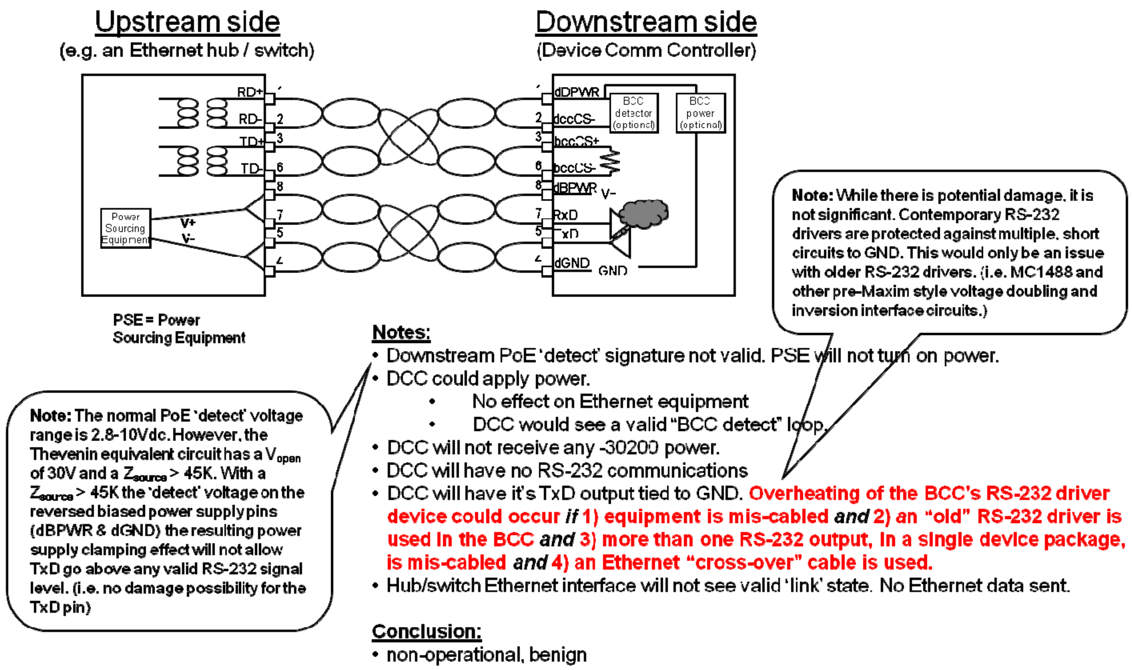


Figure O.20—Scenario 15: Upstream—PoE: alternative B/downstream—30200: DCC

O.3.3.16 Scenario 16

Scenario Group F: BCC "cross-over" cabled to an Ethernet wall receptacle.

Scenario 16: Upstream—Standard Ethernet/downstream—30200: BCC

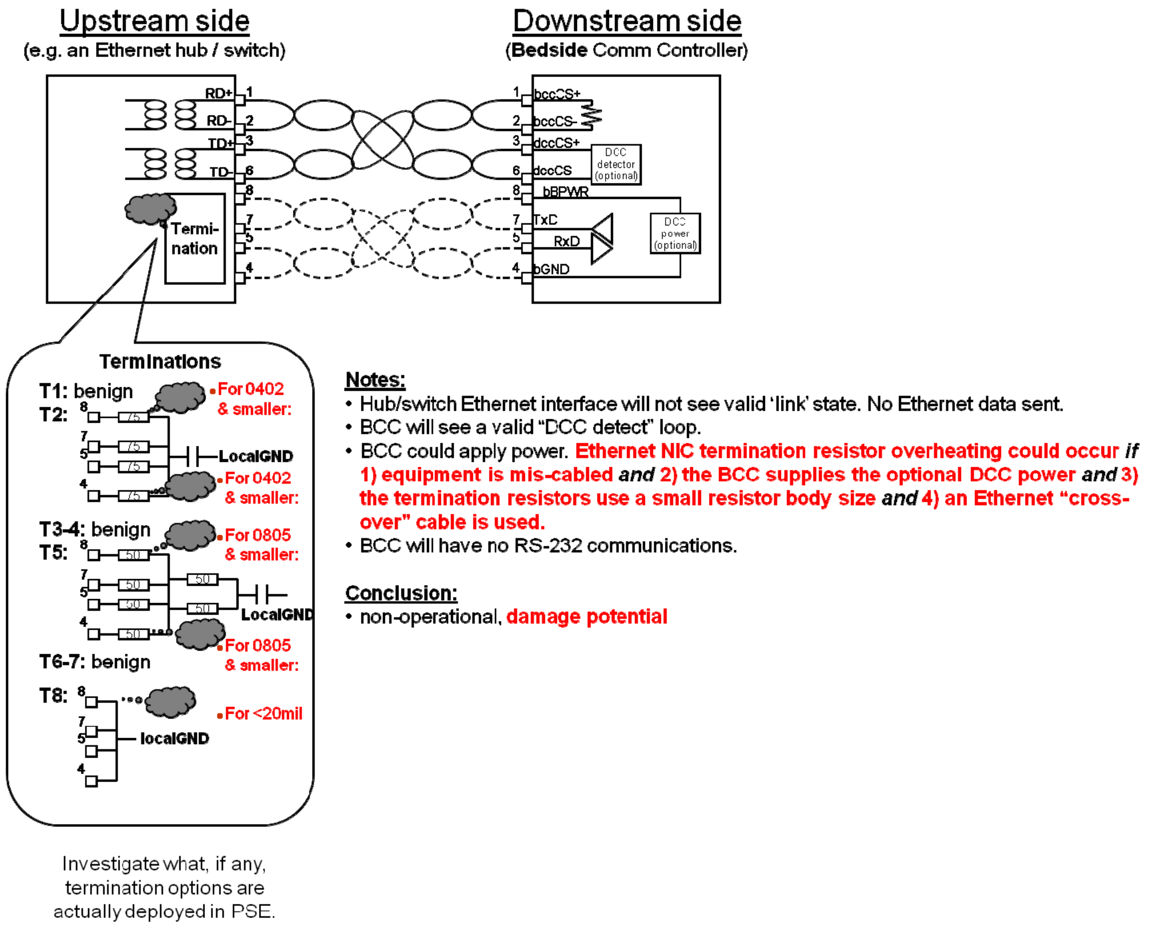


Figure O.21—Scenario 16: Upstream—Standard Ethernet/downstream—30200: BCC

O.3.3.17 Scenario 17

Scenario Group F: BCC "cross-over" cabled to an Ethernet wall receptacle.

Scenario 17: Upstream—PoE: alternative A/downstream—30200: BCC

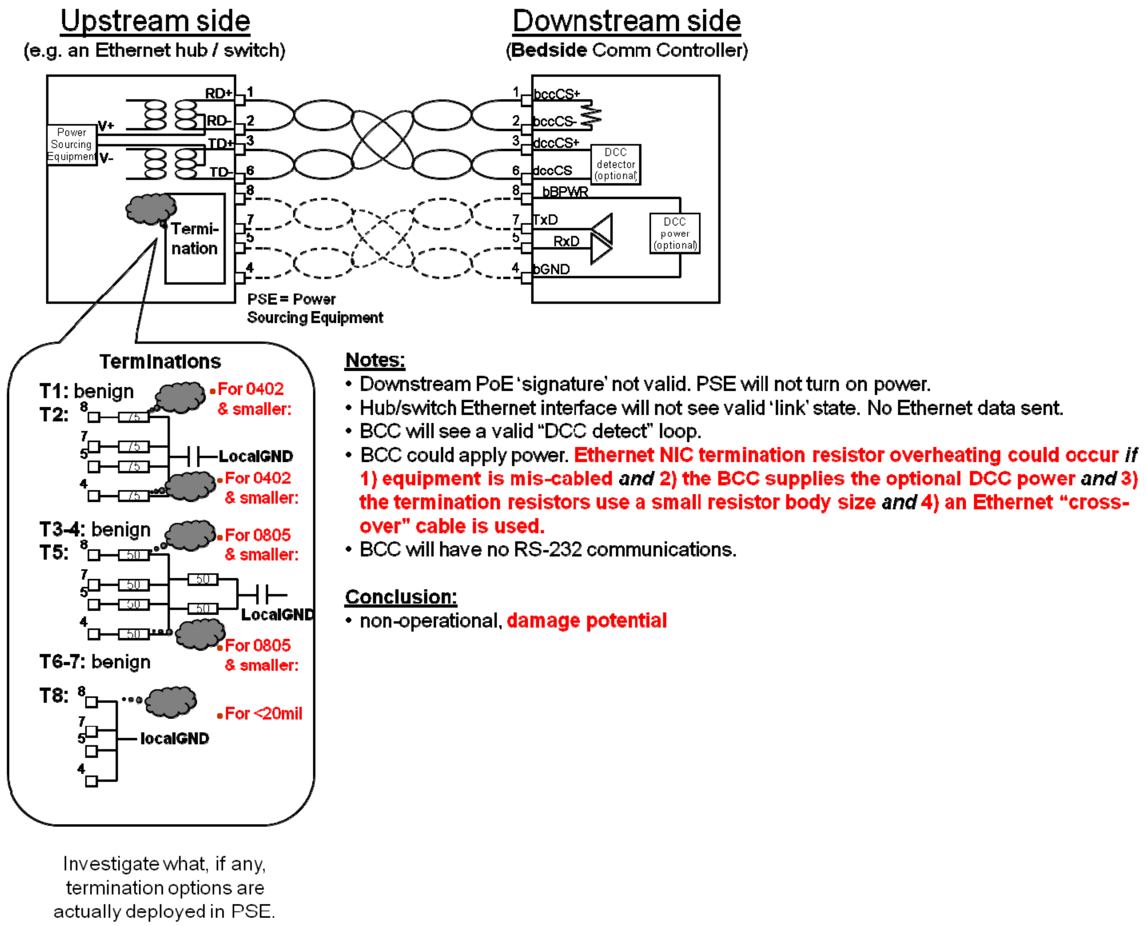


Figure O.22—Scenario 17: Upstream—PoE: alternative A/downstream—30200: BCC

O.3.3.18 Scenario 18

Scenario Group F: BCC "cross-over" cabled to an Ethernet wall receptacle.

Scenario 18: Upstream—PoE: alternative B/downstream—30200: BCC

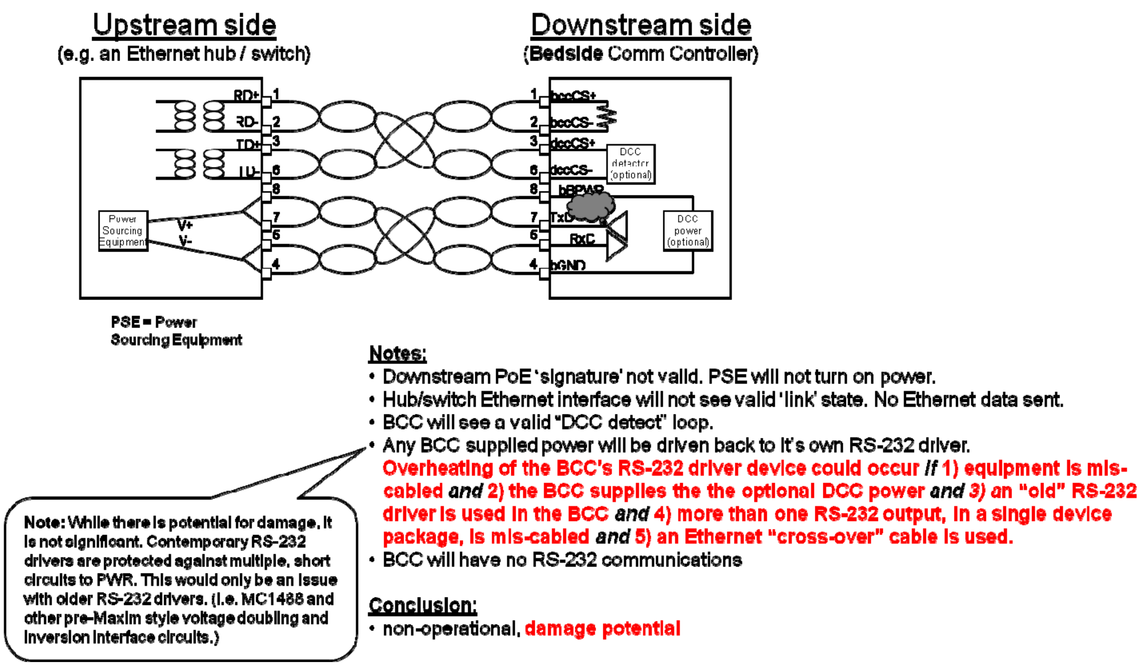


Figure O.23—Scenario 18: Upstream—PoE: alternative B/downstream—30200: BCC

O.3.3.19 Scenario 19

Scenario Group G: BCC "cross-over" cabled to an Ethernet device.

Scenario 19: Upstream—30200: BCC/downstream—Standard Ethernet

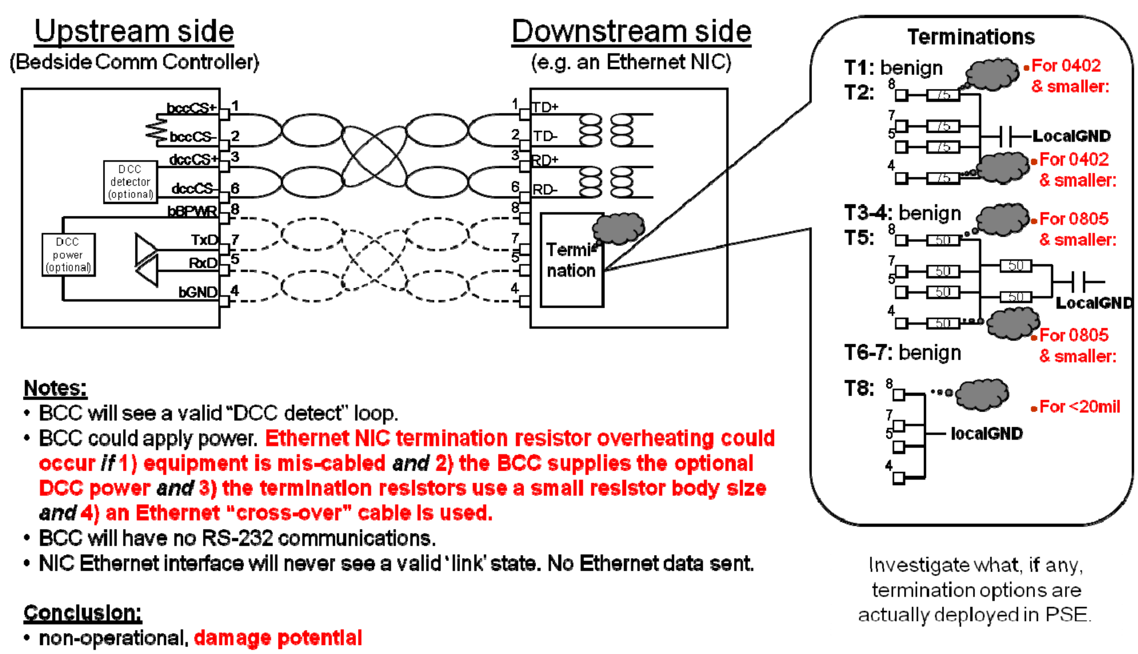


Figure O.24—Scenario 19: Upstream—30200: BCC/downstream—Standard Ethernet

O.3.3.20 Scenario 20

Scenario Group G: BCC “cross-over” cabled to an Ethernet device.

Scenario 20: Upstream—30200: BCC/downstream—PoE: alternative A

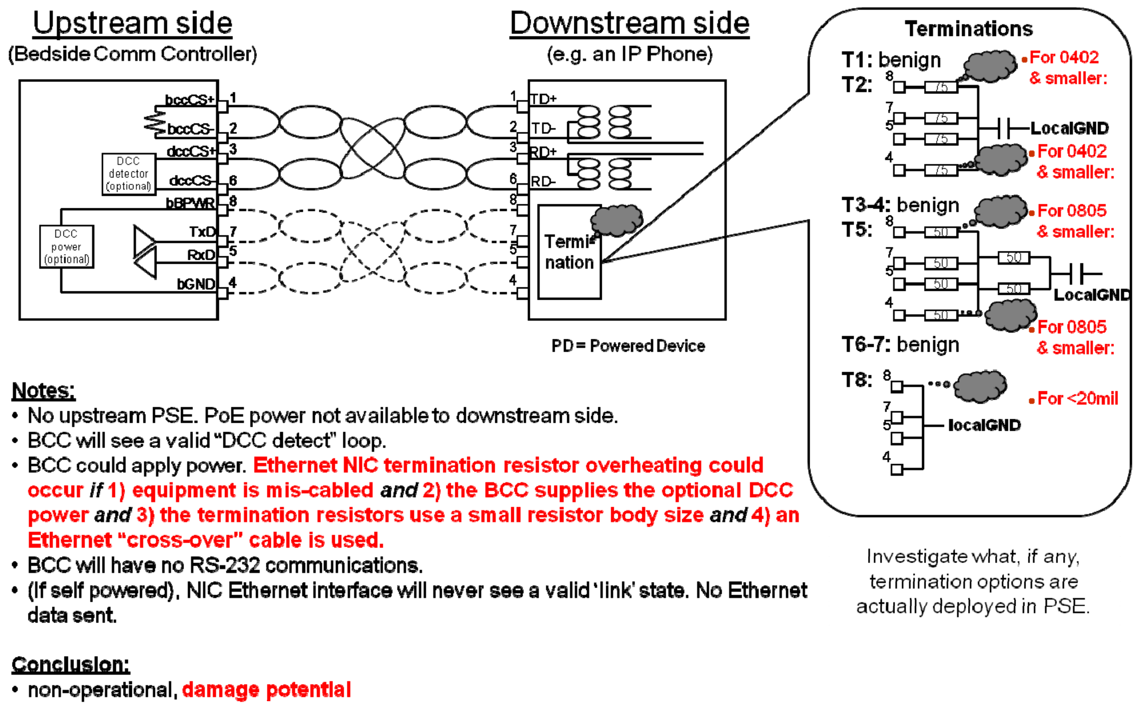


Figure O.25—Scenario 20: Upstream—30200: BCC/downstream—PoE: alternative A

O.3.3.21 Scenario 21

Scenario Group G: BCC “cross-over” cabled to an Ethernet device.

Scenario 21: Upstream—30200: BCC /downstream—PoE: alternative B

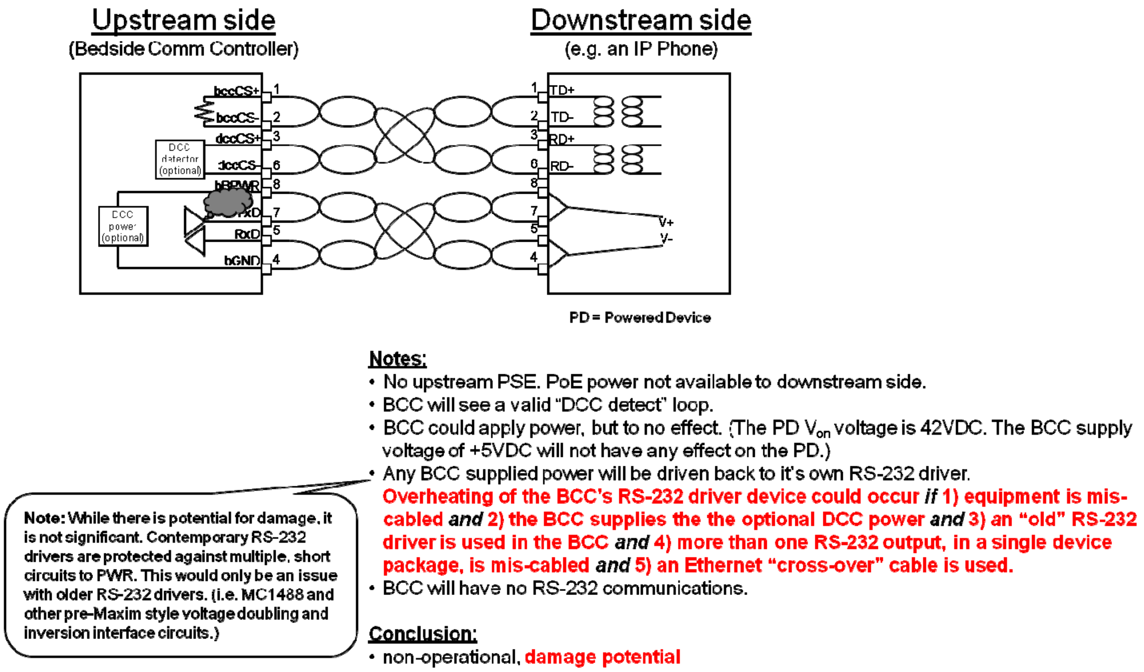


Figure O.26—Scenario 21: Upstream—30200: BCC/downstream—PoE: alternative B

O.3.3.22 Scenario 22

Scenario Group H: DCC "cross-over" cabled to an Ethernet device

Scenario 22: Upstream—30200: DCC/downstream—Standard Ethernet

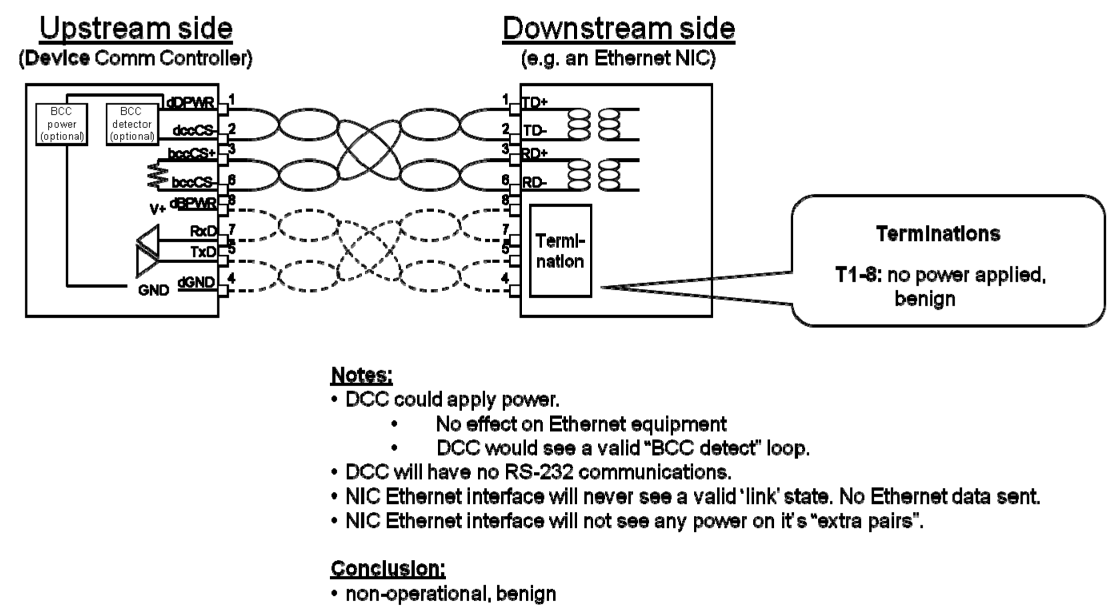


Figure O.27—Scenario 22: Upstream—30200: DCC/downstream—Standard Ethernet

O.3.3.23 Scenario 23

Scenario Group H: DCC “cross-over” cabled to an Ethernet device.

Scenario 23: Upstream—30200: DCC/downstream—PoE: alternative A

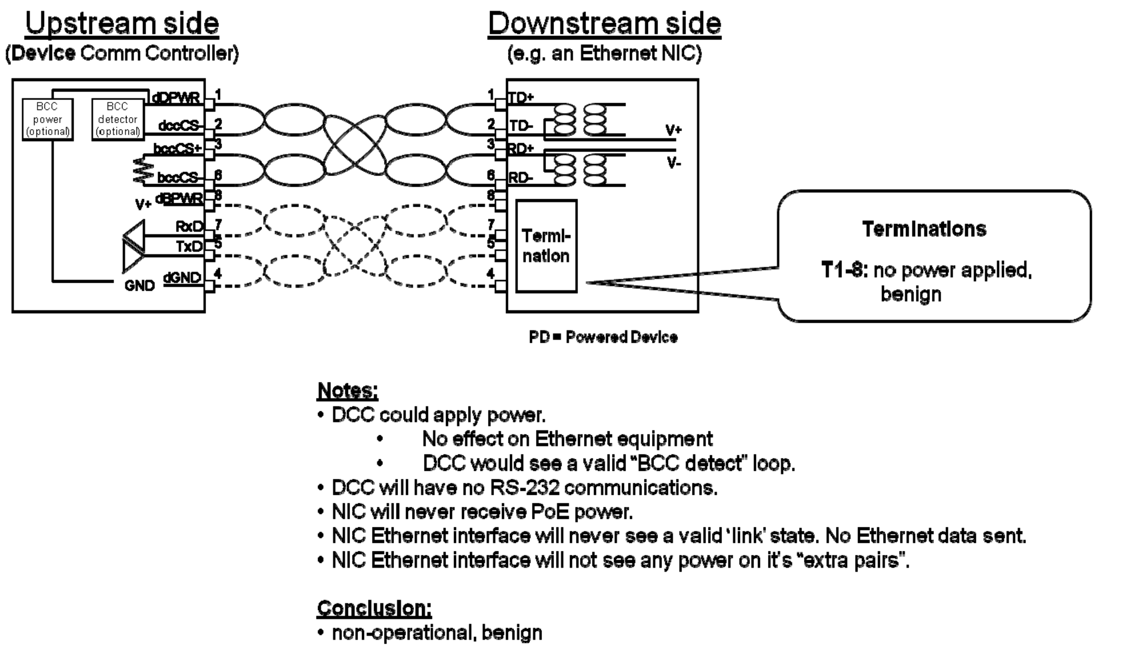


Figure O.28—Scenario 23: Upstream—30200: DCC/downstream—PoE: alternative A

O.3.3.24 Scenario 24

Scenario Group H: DCC “cross-over” cabled to an Ethernet device.

Scenario 24: Upstream—30200: DCC/downstream—PoE: alternative B

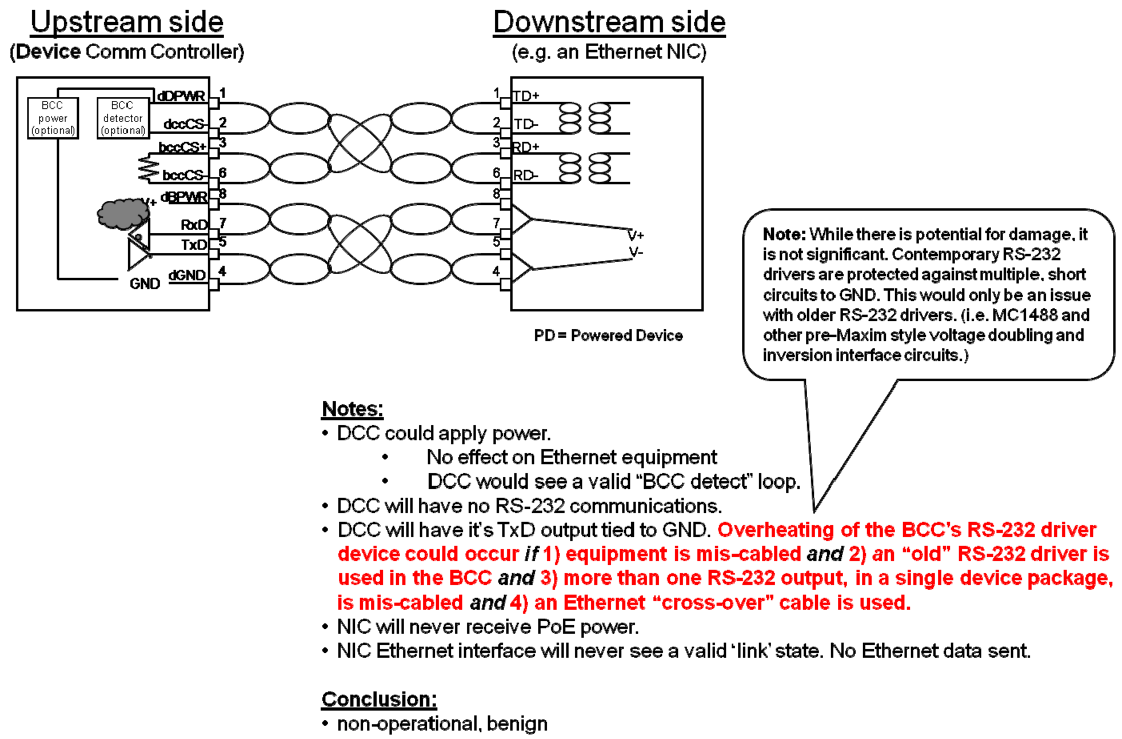


Figure O.29—Scenario 24: Upstream—30200: DCC/downstream—PoE: alternative B

Change Annex O title from the base standard as shown:

Annex ~~O~~P

(informative)

Bibliography

Insert new opening paragraph as shown:

Bibliographical references are resources that provide additional or helpful material but do not need to be understood or used to implement this standard. Reference to these resources is made for informational use only.

Insert new references as shown:

[B5] EN 62304:2005, Medical Device Software—Software Life-Cycle Processes.[3]

[B6] IEC 60601-1 Ed. 3, 2005, Medical Electrical Equipment—Part 1: General Requirements for Basic Safety and Essential Performance.[4]

[B7] IEC 60601-1-1 Ed. 2, 2000, Medical Electrical Equipment—Part 1-1: General Requirements for Safety—Collateral Standard: Safety Requirements for Medical Electrical Systems.

[B8] IEC 60601-2-2007, Medical Electrical Equipment—Part 2-XX: Particular Requirements for the Basic Safety and Essential Performance for Specific Device.

[B9] IEC 80001-1:2010, Application of Risk Management for IT-Networks Incorporating Medical Devices—Part 1: Roles, Responsibilities, and Activities.

[B10] IEEE Std 802.3™-2008, IEEE Standard for Information Technology—Telecommunications and Information Exchange Between Systems—Local and Metropolitan Area Networks—Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.[5,6]

[B11] ISO 14971:2007, Medical Devices—Application of Risk Management to Medical Devices.[7]

[3] EN publications are available from the European Committee for Standardization (CEN), 36, rue de Stassart, B-1050 Brussels, Belgium (http://www.cenorm.be).

[4] IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse (http://www.iec.ch/). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

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