

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA

**IN RE PAPST LICENSING GMBH & CO.
KG LITIGATION**

**This Document Relates To:
ALL CASES**

**Misc. Action No. 07-493 (RMC)
MDL Docket No. 1880**

PAPST LICENSING'S REPLY MARKMAN BRIEF

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I. INTRODUCTION

In an effort to help the Court understand the technology at issue, Papst set forth a summary of how the patent-in-suit described the state of art and how the invention improved upon the state of the art. Papst's Markman Brief, pp. 1-6. This is relevant to help put the Court in a position of reading the claims as one of ordinary skill in the art would read the claims. Papst also provided a brief description of the digital cameras in suit, so that the Court could focus on the claim terms that genuinely mattered.

The Camera Manufacturers' criticisms of this introduction of highly-technical subject matter are unfounded. First, the description of the problems with "specific drivers" is not a mere "story" as argued by the Camera Manufacturers. Camera Manufacturers' Opening Markman Brief (herein, "Response Brief"), pp. 1-2. The description of the problems with "specific drivers" is found in the patents in suit themselves. *E.g.*, U.S. Patent No. 6,470,399, columns 1 and 2 (Ex. A). Also, the '692 patent cited on page 1 of the Response Brief does not disclose the invention because the '399 patent was found to be patentable over that reference. Moreover, the '692 patent requires someone to execute special Unix commands (such as "mkfs" or "newfs") for the host computer to install a file system on the scanner. See Ex. B to the Response Brief, col. 4, lines 26-36. This ability is not required by the present invention.

Moreover, notwithstanding the criticisms of the background information provided by Papst, the Camera Manufacturers do nothing to put the Court in a position of understanding the basic technology at issue, or the problems solved by the invention. Simply referencing multiple dictionary definitions of words not even included in the claims is not helpful. Instead, Papst properly provided an expert declaration (Locke Declaration, Ex. C) to help the Court understand

how one of ordinary skill in the art would read and understand the technical language of the patents in suit.

II. ARGUMENT

A. The Camera Manufacturers Misstate The Law Concerning Reference To The Digital Cameras In Suit.

In its opening Markman Brief, Papst explained that while the meaning of any particular claim term should not turn on an examination of the accused devices, the digital cameras in suit may be kept in mind. Papst's Markman Brief, p. 12. The Federal Circuit has approved of this practice because it is more efficient for the Court to focus on the claim elements that are actually disputed by the parties and are most relevant to the claim construction process. *Scripps Clinic & Research Foundation v. Genentech, Inc.*, 927 F.2d 1565, 1580 (Fed. Cir. 1991); *Serio-US Indus. v. Plastic Recovery Techs. Corp.*, 459 F.3d 1311, 1319 (Fed. Cir. 2006).

The Camera Manufacturers do not attempt to distinguish the cases cited by Papst. Instead, the Response Brief, at page 6, cites to a plurality opinion from 1985, and then ***misstates the substance*** of a more recent 2006 Federal Circuit decision. The Camera Manufacturers cited *Exigent Technology* case as if the Federal Circuit found error with the district court:

Accord[.] Exigent Tech., Inc. v. Atrana Solutions, Inc., 442 F.3d 1301, 1309 n 10 (Fed. Cir. 2006) ("the district court's grant of summary judgment was in error because the court considered the accused product in rendering its claim construction.").

Response Brief, p. 6. This quote misrepresents *Exigent Technology*. First, the Camera Manufacturers cropped the first part of the sentence ("Exigent also argues that"), which indicates that the quote was merely a party's argument and not a holding of the Federal Circuit. Second,

and more importantly, the Federal Circuit *rejected* the argument quoted by the Camera Manufacturers and **upheld as proper the district court's consideration of the accused device:**

Exigent also argues that the district court's grant of summary judgment was in error because the court considered the accused product in rendering its claim construction. It is true that “[a] claim is construed in the light of the claim language . . . not in light of the accused device.” *SRI Int'l v. Matsushita Elec. Corp. of Am.*, 775 F.2d 1107, 1118 (Fed. Cir. 1985) (en banc). However, **it is appropriate for a court to consider the accused device when determining what aspect of the claim should be construed.** *See, e.g., Pall Corp. v. Hemasure Inc.*, 181 F.3d 1305, 1308 (Fed. Cir. 1999) (“Although the construction of the claim is independent of the device charged with infringement, **it is convenient for the court to concentrate on those aspects of the claim whose relation to the accused device is in dispute.**”); *Scripps Clinic & Research Found. v. Genentech, Inc.*, 927 F.2d 1565, 1580 (Fed. Cir. 1991) (“In ‘claim construction’ the words of the claims are construed independent of the accused product **Of course the particular accused product (or process) is kept in mind,** for it is efficient to focus on the construction of only the disputed elements or limitations of the claims.”); *see also* DONALD S. CHISUM, CHISUM ON PATENTS, § 18.03 at 18-71-18-74 (2005). **That is all the district court did here, and that was not error.**

Exigent Tech., Inc. v. Atrana Solutions, Inc., 442 F.3d 1301, 1309 n.10 (Fed. Cir. 2006) (emphasis added). The Camera Manufacturers quoted only the portion underlined above, and concealed the fact that the Federal Circuit actually upheld the district court's consideration of the accused devices.

The Camera Manufacturers compound this error when they argue at the end of the Response Brief that “the Court should instead focus its energies on terms that currently appear to make a substantive difference in the case.” Response Brief, p. 43. However, this is the very reason to consider the accused devices. *E.g., Pall Corp. v. Hemasure Inc.*, 181 F.3d 1305, 1308 (Fed. Cir. 1999) (“it is convenient for **the court to concentrate** on those aspects of the claim whose relation to the accused device is in dispute.”); *Scripps Clinic*, 927 F.2d at 1580 (Fed. Cir. 1991) (“the particular accused product (or process) is kept in mind, for **it is efficient to focus on the construction** of only the disputed elements or limitations of the claims.”).

A comparison of the accused devices to the infringement contentions of the Camera Manufacturers illustrates how consideration of the digital cameras in suit will help the Court to “focus its energies on terms that currently appear to make a substantive difference in the case.” The digital cameras in suit have interface devices. Papst’s Markman Brief, p. 6. Those interface devices, however, are not likely to be easily separable from the rest of the digital camera. Accordingly, it is not surprising that the Camera Manufacturers seek to limit the claimed interface devices to “stand-alone” devices. *See* Response Brief, p. 12.

What is surprising is that the Camera Manufacturers appear to take a diametrically opposed view to claim construction when it comes to its invalidity contention. The Camera Manufacturers assert that numerous digital cameras *include* “interface devices,” even though they are not “stand-alone” interface devices. For example, the Camera Manufacturers contend that: “The **QV-10 camera includes an interface device** that is formed by at least a portion of the CPU and the on-chip memory that are part of the camera.” Camera Manufacturers’ Invalidity Contentions Exhibit A55, p. 3 (Dkt. No. 139-57) (emphasis added). Similar contentions are made with respect to numerous other cameras. *See* Camera Manufacturers’ Invalidity Contentions, Exhibits A6, A13, A22, A24, A25, A28, A30, A33, A35, A40, A45, A56, A57, A58, A62, and A77. These invalidity contentions are hopelessly in conflict with the arguments made by the Camera Manufacturers in their Response Brief.¹

¹ Regarding the argument at hand, Papst’s position is consistent for both validity and infringement. *See, e.g., Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1330 (Fed. Cir. 2003) (“It is axiomatic that claims are construed the same way for both invalidity and infringement.”). As explained in more detail in Section D below, the claims do not recite any structure which would preclude the interface device, as claimed, from being part of a larger product.

This comparison of the digital cameras in suit and the invalidity contentions of the Camera Manufacturers will help the Court “focus its energies” on claim terms that matter, such as the one above. The Court should not abandon the usefulness of putting this case into proper context based on the erroneous citation of *Exigent Technology* by the Camera Manufacturers.

B. The Language Of The Claims, Not Examples In The Specification, Determines The Scope Of The Claims.

The Camera Manufacturers appear to agree with Papst that the claim language itself is controlling. Response Brief, p. 4 (citing *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc) for the proposition that: “It is a ‘bedrock principle’ of patent law that ‘the claims of a patent define the invention to which the patentee is entitled the right to exclude’”). However, the Response Brief soon departs from this fundamental principal and erroneously seeks to add limitations that are not recited in the claims. The Court should reject the Camera Manufacturers’ erroneous attempt to re-write the claims.

Additionally, the Camera Manufacturers make no attempt to adhere to the *en banc* decision from the Federal Circuit, which has “repeatedly warned against confining the claims” to the embodiments shown in the specification. *Phillips*, 415 F.3d at 1323 (“although the specification often describes very specific embodiments of the invention, we have repeatedly warned against confining the claims to those embodiments.”). Nor do the Camera Manufacturers attempt to distinguish *Superguide Corp. v. DirecTV Enters.*, 358 F.3d 870, 875, 881 (Fed. Cir. 2004) (“a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment.”), or *Burke, Inc. v. Bruno Independent Living Aids, Inc.*, 183 F.3d 1334, 1340 (Fed. Cir. 1999) (“Consistent with the principle that the patented invention is defined by the claims, we have often held that limitations

cannot be read into the claims from the specification or the prosecution history.”), as cited in Papst’s Markman Brief. This is because the “purposes of the specification are to teach and enable those of skill in the art to make and use the invention and to provide a best mode for doing so.” *Phillips*, 415 F.3d at 1323. “One of the best ways to teach a person of ordinary skill in the art how to make and use the invention is to provide an example of how to practice the invention in a particular case.” *Id.* However, having provided such an example, the invention is not limited to that example.

Instead of attempting to address these cases, the Camera Manufacturers incorrectly argue that the claims “cannot be construed as broader than what is described in the specification as the invention.” Response Brief, p. 4. This argument misses the point, because the structure expressly claimed in the body of the claims is not broader than the structure that is disclosed in the written description. Additionally, the cases cited by the Camera Manufacturers, *Inpro II Licensing S.A.R.L. v. T-Mobile USA, Inc.*, 450 F.3d 1350 (Fed. Cir. 2006) or *Microsoft Corp. v. Multi-Tech Sys. Inc.*, 357 F.3d 1340 (Fed. Cir. 2004), are distinguishable. In *Inpro II*, the claims were limited to parallel connections because the patent specification emphasized “the importance of a parallel connection in solving the problems of the previously used serial connection.” *Inpro II*, 450 F.3d at 1354-55. In *Microsoft*, the patentee “repeatedly and consistently” required the invention to operate over telephone lines. The present case is different because the specification does not make any attempt to distinguish a stand-alone embodiment from an interface device as part of a larger product.

The actual claim language controls the scope of the invention protected by the patents in suit. The Camera Manufacturers' inapplicable arguments to limit the claims to certain examples given in the specifications of the patents should be rejected.

C. Consideration Of Expert Testimony Is Proper To Understand The Viewpoint Of One Of Ordinary Skill In The Art.

The Camera Manufacturers do not dispute that a "starting point" for claim construction is "the well-settled understanding that inventors are typically persons skilled in the field of the invention and that patents are addressed to and intended to be read by others of skill in the pertinent art." *Phillips*, 415 F.3d. at 1313. Nor do the Camera Manufacturers dispute that the terms used in a patent claim are presumed to have the ordinary meaning **that are attributed to those words by persons skilled in the art.** *Phillips*, 415 F.3d at 1313; *Johnson Worldwide Assocs. v. Zebco Corp.*, 175 F.3d 985, 989 (Fed. Cir. 1999). However, the Camera Manufacturers do not provide the Court with appropriate information sufficient to put the Court in a position where it can read the claims from the viewpoint of one of ordinary skill in the art.

The dictionary definitions provided by the Camera Manufacturers are unhelpful. In another example, the Camera Manufacturers provide dictionary entries for "driver" and "device driver," comprising multiple different definitions. However, the Camera Manufacturers provide no basis as to why a person of ordinary skill in the art would look to one definition and reject the others when it comes to the patents in suit. *See, e.g., Renishaw PLC v. Marposs Societa' Per Azioni*, 158 F. 3d 1243, 1250 (Fed. Cir. 1998) ("Indiscriminate reliance on definitions found in dictionaries can often produce absurd results"). In another example, the Camera Manufacturers provide several dictionary definitions for the word "connector." These dictionary entries are irrelevant because the word "connector" is not found in the claims at issue. Because

the term is absent from the claims, it would be error to define the term “connector” and so limit the claims. *NTP, Inc. v. Research In Motion, Ltd.*, 418 F.3d 1282, 1310 (Fed. Cir. 2005) (a “textual ‘hook’ in the claim language” is required). *See also Johnson Worldwide*, 175 F.3d at 990 (“[T]here must be a textual reference in the actual language of the claim with which to associate a proffered claim construction.”).

While the term “connector” is not found in the claims, the phrases “first connecting device for interfacing” and “second connecting device for interfacing” are found. These phrases are not found in the dictionary cited by the Camera Manufacturers. However, THE IEEE STANDARD DICTIONARY OF ELECTRICAL AND ELECTRONICS TERMS (6th ed. 1996) *does* have entries for “device” and “interface.” The term “device” has 13 distinct definitions, none of which require “connectors.” THE IEEE STANDARD DICTIONARY OF ELECTRICAL AND ELECTRONICS TERMS, p. 279 (Ex. F). The term “interface” has 22 entries, many with discrete sub-parts. Ex. F, pp. 540-541. The Camera Manufacturers provide no explanation as to why “connector” has any relevance to the claims (even though it is not recited in the claims), while the actual words that are recited in the claims are ignored.

Moreover, these contain numerous, often contradictory definitions. Papst respectfully submits that, if the Court wishes to sort through which of these entries are relevant to the claims and technology at issue, expert technical assistance would be invaluable. *Serio-US Industries, Inc. v. Plastic Recovery Technologies Corp.*, 459 F.3d 1311, 1319 (Fed. Cir. 2006) (“Trial courts have the discretion to hear expert testimony in connection with claim construction issues.”).

D. The Invention Is Defined In The Body Of The Claim, Not In The Preamble.

In the claims at issue, the recitation of “An interface device . . . comprising:” is an unmistakable signal to patent practitioners, and to the Court, that the term “interface device” is simply a name given to the invention for ease of reference later in the claim. The interface device is then completely defined in the body of the claim (following the word “comprising”) by the elements of the claim, and the relationship between the elements.

Patent Practitioners are taught to name the invention in the preamble, and to use the preamble as an introduction:

Claims should have “preambles,” or introductory statements, the purposes of which are to indicate the statutory class of the claim (often by implication from the words of the preamble) and to name or define the thing that is to be claimed.

ROBERT C. FABER, LANDIS ON MECHANICS OF CLAIM DRAFTING, §2:4. (Ex. D). After naming the invention in the preamble, patent practitioners are taught to list the elements of the invention in the body of the claim:

The body of a combination claim, meaning the part that follows the preamble and the transitional phrase, comprises:

- a. recitation of the “elements” of parts of the combination, and
- b. descriptions of how the elements cooperate with one another structurally, physically, or functionally, to make up the operative combination recited in the preamble. . . .

ROBERT C. FABER, LANDIS ON MECHANICS OF CLAIM DRAFTING, §2:7. (Ex. D). The claims under consideration by the Court follow this well accepted, textbook practice of naming the invention in the preamble (i.e., an “interface device”) and then defining the invention in the body of the claim.

The Camera Manufacturers seek to turn this traditional practice on its head. The Camera Manufacturers are wrong to attempt to add limitations to the term “interface device” as it appears in the preamble, because the precise elements and relationships of those elements are expressly defined in the body of each claim at issue. In addition to going against traditional claim drafting practices, any attempt to define “interface device” by referring to statements about “the present invention” in the specification is improper. *Phillips*, 415 F.3d at 1323 (“In particular, we have expressly rejected the contention that if a patent describes only a single embodiment, the claims of the patent must be construed as being limited to that embodiment.”).

There is no basis in the claims for limiting the interface device to a stand-alone device. The Camera Manufacturers rely on the phrase “regardless of the type of the data transmit/receive device attached to the second connecting device” as somehow indicating that the claims are limited to a stand alone device. However, the patent uses the term “attached” to refer to both permanent connections and removable connections. Ex. A, col. 5, lines 50-52 (“The connecting device is attached both to a digital signal processor 13 and to a memory means 14.”); col. 9, lines 23-24 (“An 80-MHz clock generator is attached to the DSP 1300 in order to synchronize the DSP.”). There can be no question that, in the preferred embodiment, the 80-MHz clock generator and the connecting device are permanently connected to the digital signal processor. The word “attached,” as it is used in the patents in suit, encompasses such permanent attachments. Accordingly, the phrase that the data transmit/receive device is “attached” to the second connecting device does not imply or require that the data transmit/receive device be easily removable.

Additionally, the recitation of “data transmit/receive device” and “host device” in preamble should not be construed to be claim limitations. The claim preambles at issue are like those in *Vaupel Textilmaschinen KG v. Meccanica Euro Italia S.P.A.*, 944 F.2d 870, 880 (Fed. Cir. 1991) and *C. R. Bard, Inc. v. M3 Systems, Inc.*, 157 F.3d 1340 (Fed. Cir. 1998), which were found to be not limiting because the language at issue merely provided a reference point for describing the invention. In *Vaupel*, the preamble of claim 2 recited:

2. In a broad fabric weaving machine having a sley and a breast plate for forming a plurality of strips of fabric from threads of synthetic fiber, the improvement comprising:

Vaupel, 944 F.2d at 872. The Federal Circuit held that the term “breast plate,” as recited in the preamble and later referenced in the body of the claim, was not a limitation:

“Breast beam” and “breast plate” are not structural limitations of Claims 1 and 2; as used in Claims 1 and 2, they indicate a reference point to fix the direction of movement of the woven fabric from the loom. Such alleged loom “parts” are not illustrated in any of the figures of the ‘650 patent or otherwise described in the specification.

Vaupel, 944 F.2d at 880. Here, as in *Vaupel*, the host computer and the data transmit/receive device are not illustrated in the ‘399 patent or the ‘449 patent. That is because the invention comprises the interface device itself. Also, as in *Vaupel*, the recitation of the host computer and the data transmit/receive device in the preambles serve as mere reference points for later descriptions of the inventive interface device.

A similar result was reached in *C. R. Bard*. In that case, claim 21 of the patent recited a biopsy needle in relation to a biopsy gun (called a “tissue sampling device” in the claims) in which the biopsy needle was to be used:

21. A biopsy needle for use with a tissue sampling device having a housing with a forward end, a first slide mounted for longitudinal motion within said housing,

and a second slide mounted for longitudinal motion within said housing, said biopsy needle comprising:

C. R. Bard, 157 F.3d at 1348-49. The Federal Circuit held that the claim was properly construed to recite a separate claim for a needle, and that the tissue sampling device simply provided an aid in defining the needles:

In the case at bar, the preamble of claim 21 recites the portion and structure of the gun housing into which the needles fit, **and provides reference points in the gun that aid in defining the needles** as set forth in the body of the claim. M3 Systems is incorrect in stating that the preamble must contain details of the integrated mechanical cocking structure, **for the gun structure is not part of the separate claims to the needles.**

C. R. Bard, 157 F.3d at 1350 (emphasis added). Here, as in *C. R. Bard*, the host computer and the data transmit/receive device provide mere reference points to aid in defining the interface device.

The Court should apply the analysis from *Vaupel* and *C. R. Bard* to the claims at issue. Claim 1 of the '399 patent has a preamble that identifies an "interface device," and then recites an intended use for that interface device:

An interface device *for communication between a host device, which comprises drivers for input/output devices customary in a host device and a multi-purpose interface, and a data transmit/receive device, the data transmit/receive device being arranged for providing analog data, comprising:*

Ex. A, claim 1 (emphasis added). See also Ex. A, claim 14, Ex. B, claims 1 and 17. The italicized portion of the preamble is merely the intended purpose for the interface device, and is not limiting. *Catalina Marketing International, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 809 (Fed. Cir. 2002). Like the claims in *Vaupel* and *C. R. Bard*, the host device and data transmit/receive device are used as mere aids to define the interface device.

The cases cited by the Camera Manufacturers are distinguishable. In *Computer Docking Station Corp. v. Dell, Inc.*, 519 F.3d 1366 (Fed. Cir. 2008), the entire preamble of one of the claims at issue is as follows:

A portable computer comprising:

Id. at 1371. This preamble is not like the preambles at issue in the patents-in-suit because there is no recitation of reference points which would be used as aids to define the invention. Moreover, in *Computer Docking Station*, neither party disputed that the “portable computer” language limited the scope of the claims. It is not surprising that the Federal Circuit found that “portable computer” meant a portable computer. Also, in the ‘399 patent, the amendment to the preamble was to conform the description of the data transmit/receive device to the amendments made to the second connecting device. The case is distinguishable for this reason as well. The other case cited by the Camera Manufacturers, *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 952-53 (Fed. Cir. 2006), is distinguishable because the body of the claim in that case failed to define a complete invention. Here, in contrast, the body of the claim defines a complete interface device, and *Bicon* is inapposite.

Even if the preamble were found to be limiting (it is not), the interpretations requested by the Camera Manufacturers are erroneous. The Camera Manufacturers’ proposed definition for “data transmit/receive device is directly contrary to the express definition in the patents. A patentee is allowed to be his own lexicographer. *Phillips*, 415 F.3d at 1316. Here, the patentee defined the term “data transmit/receive device” as follows:

[a] data transmit/receive device from which data is to be acquired or with which two-way communication is to take place.”

Ex. A, col. 1, lines 12-14 (emphasis added).² The use of the word “or” expressly indicates an alternative. The Court should not ignore the fact that the inventor defined the term “data transmit/receive device” to mean a device “from which data is to be acquired” or, in the alternative, “with which two-way communication is to take place.”

This definition also sheds light on the meaning of the phrase “communication between.” The phrase “communication between” a host computer and a data transmit receive/device is used in the context of these alternative communications. Ex. A, col. 1, lines 9-14. In this regard, the “communication between” a host computer and a data transmit receive device may comprise the data to be acquired by the data transmit/receive device, or, in the alternative, it may comprise two-way communication with the data transmit/receive device.

The prosecution history also supports construing “data transmit/receive device” to mean a device “from which data is to be acquired.” While the ‘399 patent was pending, the inventor amended claim 1 to so that the data transmit/receive device is recited as “being arranged for *providing* analog data.” Ex. D to Papst’s Markman Brief, PAP0009285-87 (emphasis added). There is no corresponding amendment to the language requiring “two-way communication.” For example, the claim **does not** recite that the interface device is arranged for providing any data to the data transmit/receive device. In short, there is nothing in the prosecution history or the claims that would require “two-way communication.”

² Papst need not address the Camera Manufacturers’ straw man argument (Response Brief, p. 10) concerning the purported interpretation of a slash mark (“/”). As set forth above, Papst relies on the express definition in the specification, not a purported interpretation of a punctuation symbol.

The arguments of the Camera Manufacturers regarding the purported “plain” meanings of “communication” and “between” should be rejected. The Camera Manufacturers provide no evidence that a person of ordinary skill in the art would understand “communication between” to require “two-way” communication. For example, contrary to the Camera Manufacturers’ argument, a television broadcast may be considered a communication between a transmitter and television, even though the television does not send any signals back to the transmitter. Mere conjecture on the part of the Camera Manufacturers that “communication between” has some special meaning, without evidence, is not sufficient.

The Camera Manufacturers’ argument concerning the term “host device” is without substance. There is no description in the specification even suggesting that the host device “must also connect to and control the operation of peripherals,” as argued by the Camera Manufacturers. Response Brief, p. 9. Moreover, the Camera Manufacturers have provided no context as to why the Court should “focus its energies” on this issue. In their invalidity contentions, for example, the Camera Manufacturers contend that the term “host device” reads on “a PC that utilizes driver for a variety of input/output devices.” Camera Manufacturers’ Invalidity Contentions Exhibit A55, p. 1 (Dkt. No. 139-57) (emphasis added). There is no contention that the PC has to control anything.

E. The Camera Manufacturers Misconstrue The Terms In The Bodies Of The Claims.

1. A “Connecting Device” Is A Device, Not A Connector.

The Camera Manufacturers improperly attempt to limit the “first connecting device” and the “second connecting device” to mere connectors. The Camera Manufacturers incorrectly argue that: “Throughout the specification, the patentee uses the term “interface” to mean

physically connecting.” Response Brief, p. 15. This is incorrect, because the portion of the specification cited by the Camera Manufacturers distinguishes the “interface” from the “connector”:

“The SCSI (small computer system interface) **interface 1220 translates the data** received via the SCSI connector 1240 into data understood by the DSP 1300, as known by those skilled in the art.

Ex. A, col. 9, lines 33-37. In this regard, the data comes from the “connector,” but it is the “interface” that “translates the data.”

Moreover, the claims do not say “connector.” In contrast, the claims recite that the “connecting devices” are for “interfacing:”

a first connecting device for interfacing the host device with the interface device via the multi-purpose interface of the host device; and

a second connecting device for interfacing the interface device with the data transmit/receive device, the second connecting device including a sampling circuit for sampling the analog data provided by the data transmit/receive device and an analog-to-digital converter for converting data sampled by the sampling circuit into digital data

Ex. A, claim 1 (emphasis added). The word “interface” has more than 20 definitions in a technical dictionary cited by the Camera Manufacturers. Ex. F, pp. 540-41. A concept common to many of the entries for “interface” is that an interface is a common or shared boundary through which information is conveyed. The definition relating to test, measurement and diagnostic equipment, for example, concerns the circuits and signals to pass such information:

(7) (test, measurement, and diagnostic equipment) A shared boundary involving the specification of the interconnection between two equipments or systems. The specification includes the type, quantity and function of the interconnection circuits and the type and form of signals to be interchanged via those circuits. *See also: adapter.*

Ex. F, p. 541. Conspicuous by its absence is any mention of “connector.” Connectors are not relevant to this definition.

The claim construction proposed by Papst is consistent with this definition. For example, Papst requested that:

The term "second connecting device" as it is used in the '399 patent should be construed to mean the structure actually recited in claim 1, i.e., "a sampling circuit for sampling the analog data provided by the data transmit/receive device" and "an analog-to-digital converter for converting data sampled by the sampling circuit into digital data." The second connecting device should not be limited to a connector, nor should the term "interfacing" be limited to making a physical connection.

Appendix to Papst’s Markman Brief, p. 1. The “sampling circuit for sampling the analog data” and the “analog-to-digital converter” describe the type and function of the interconnection circuits. Also, the proposed construction defines the type and form of signals to be interchanged by those circuits (“analog data provided by the data transmit/receive device” and “digital data”).

In contrast, the proffered dictionary entries for the word “connector” are irrelevant because the word “connector” is not found in the claims. *NTP, Inc. v. Research In Motion, Ltd.*, 418 F.3d 1282, 1310 (Fed. Cir. 2005) (a “textual ‘hook’ in the claim language” is required). The term “first connecting device for interfacing” is not a “textual hook” for the dictionary entries for “connector” because, as set forth above, a “device for interfacing” means an electrical circuit, not a mere connector.

The Camera Manufacturers attempt to split off the term “interfacing,” and provide an argument on page 22 of the Response Brief, several pages after the Camera Manufacturer’s discussion of the first connecting device and the second connecting device on pages 15-18 of the Response Brief. It is improper to dissect and split apart claim language and attempt to define words in isolation, as the Camera Manufacturers have done. The word “interfacing” should be

construed in the context in which it is used in the claims. For example, the phrase “second connecting device for **interfacing** the interface device with the data transmit/receive device” tells one of ordinary skill in the art that, in context, “interfacing” means data communication, because the structure for the “second connecting device” is further defined as including a sampling circuit and an analog to digital converter.

Finally, the inventor could have used the word “connector” in the claims, but chose not to do so. The constructions offered by the Camera Manufacturers should be rejected for this additional reason.

2. The First Command Interpreter Identifies The Interfacing Device As If It Were A Customary Device.

The Camera Manufacturers mistakenly argue that the first command interpreter “lies” to the host computer as to the true nature of the data transmit/receive device. However, that is not what the claim says. The first command interpreter responds to an “inquiry” from the host computer concerning the type of device attached to the host computer, i.e., the interface device:

wherein the first command interpreter is configured in such a way that the command interpreter, when receiving an **inquiry** from the host device **as to a type of a device attached to the multi-purpose interface of the host device,**

Ex. A, claim 1. (emphasis added). The signal sent in response to the inquiry identifies the interface device as an input/output device customary in a host device, regardless of what data transmit/receive device may be attached:

sends a signal, **regardless of the type of the data transmit/receive device** attached to the second connecting device of the interface device, to the host device which signals to the host device that **it is an input/output device customary in a host device**

Ex. A, claim 1. (emphasis added). Here, the “it” is the interface device, not the data transmit receive device. This is confirmed by the next clause of the claim, in which the interface device (not the data transmit/receive device) is treated as an input/output device customary in a host device:

whereupon the host device communicates **with the interface device** by means of the driver for the input/output device customary in a host device,

Ex. A, claim 1. See also, Ex. A Col. 8, lines 31-33 (“many interface devices 10 can be connected to the host device which then sees many different ‘virtual’ hard disks.”).

The Camera Manufacturers point to remarks made by the patent attorney in the prosecution history to the effect that the interface device “lies to the host computer as to the real nature of the data transmit receive device.” Response Brief, p. 19. From this statement, the Camera Manufacturers incorrectly argue that the claim requires that the first command interpreter must be “lying to the host about the real nature of the data transmit/receive device . . .” and that the first command interpreter “must factor into its response the nature of the data transmit/receive device.” Response Brief, p. 20, see also, pp. 23-24. The Camera Manufacturers are wrong.

First, the claims recite that the response is sent “**regardless** of the type of the data transmit/receive device attached to the second connecting device of the interface device” Ex. A, claim 1, emphasis added. “Regardless” is the polar opposite of “factor[ing] into its response,” so the Camera Manufacturers’ argument should be rejected as contrary to the plain claim language. Second, by identifying itself as an input/output device customary in a host device, the interface device could be said to “lie” about the data transmit receive devices because customary devices (disk drives, CDRoms, etc.) do not have data transmit/receive devices. Third, to the extent that

the Camera Manufacturers argue that there is any discrepancy between the claims and the attorney's remarks, the controlling law requires this Court to give effect to the claims of the patent as finally worded, not to the remarks of an attorney. *Intervet America, Inc. v. Kee-Vet Labs., Inc.* 887 F.2d 1050, 1054 (Fed. Cir. 1989); *see also Storage Technology Corp. v. Cisco Systems, Inc.*, 329 F.3d 823, 832 (Fed. Cir. 2003) ("The applicants' inaccurate statement cannot override the claim language itself, which controls the bounds of the claim."). This is an example of when the prosecution history "lacks the clarity of the specification and thus is less useful for claim construction purposes." *Phillips*, 415 F.3d. at 1317.

Regarding the arguments that attempt to limit the "first command interpreter" to a "software program or module" (Response Brief, p. 19), or to "run a program from its memory" or "determine the data transfer parameters," (Response Brief, p. 22), the claim does not recite "software," "program," "module" or "parameter," so the Camera Manufacturers proposed constructions is erroneous. This is another example of when consideration of the accused devices may be relevant to focus the Court's energies on a particular proposed construction. The Camera Manufacturers have not identified why this particular proposed construction is at issue in the case.

Additionally, the Camera Manufacturers err when they argue that an "an inquiry from the host device" is limited to SCSI INQUIRY commands. The SCSI INQUIRY command is only one example of an inquiry given in the patent. For example, the Camera Manufacturers (Response Brief, p. 34) fail to provide the rest of the description of the "inquiry" process:

Optionally, the host device can send an instruction, known by those skilled in the art as "Test Unit Ready", to the interface device to request more precise details regarding the queried device.

The Camera Manufacturers omit the “Test Unit Ready” command, which is another example of an “inquiry.” Moreover, the claims do not use all capital letters when referring to the “inquiry.” In the technical specification that identifies and defines commands that are part of the SCSI Block Command set, the convention is that using all capital letters (“INQUIRY”) designates a specific SCSI command, whereas using lower case letters indicates that the word is ordinary English:

Names of commands, status codes, sense keys, and additional sense codes are in all uppercase (e.g., REQUEST SENSE).

* * *

Normal case is used for words having the normal English meaning.

Working Draft SCSI Block Commands – 2 (SBC-2) §3.4, pp. 8-9 (Ex. E). One of ordinary skill would apply this convention as stated in the SCSI specification which defines the INQUIRY command. Applying the convention from the SCSI specification to the present case means that “inquiry” in the claims should be given its normal English meaning because it is in lowercase letters, while “INQUIRY” in all capital letters in the specification refers to the name of the SCSI command. In other words, “inquiry” as used in the claims is not limited to the SCSI INQUIRY command.

There is no basis for the Camera Manufacturer’s proposed construction that the “second command interpreter” translate data request commands into commands “understandable by a plurality of dissimilar data transmit/receive devices.” Response Brief, p. 21. The second command interpreter need only interpret the data request command as a command for initiating the transfer of the digital data:

wherein the second command interpreter is configured to interpret a data request command from the host device to the type of input/output device signaled by the first command interpreter as a data transfer command for initiating a transfer of the digital data to the host device.

Ex. A, claim 1. There is nothing in this claim language which requires anything being translated into any commands “understandable” by a data transmit receive device. Instead, the Camera Manufacturer’s requested construction appears based on their faulty construction of the “first command interpreter.” The Camera Manufacturers do not provide any evidence or expert testimony in support of their requested construction.

The Court also should reject the Camera Manufacturers’ attempt to limit the claim phrase “digital data” to unprocessed digital data. The Camera Manufacturers do not dispute that a preferred embodiment of the inventive interface device performs digital signal processing and/or data compression. Ex. A col. 9, lines 17-32 (describing optional data compression and other operations). Also, the Camera Manufacturers make no attempt to distinguish *Cytologix Corp. v. Ventana Medical Sys. Inc.*, 424 F.3d 1168, 1173 (Fed. Cir. 2005), which reversed the construction of a base claim that would have rendered dependent claims meaningless. Here, like in *Cytologix*, dependent claims expressly recite that the digital data is “transformed” and/or “compressed.” Ex. B, claim 4 (reciting that the data acquired by the second connecting device is transformed into the frequency domain), Ex. B, claim 5 (reciting compressing data to be transmitted from the data transmit/receive device to the host device). The construction offered by the Camera Manufacturers is improper because it would render these claims meaningless.

The cases cited by the Camera Manufacturers are distinguishable. *Ampex Corp. v. Eastman Kodak Co.*, 460 F. Supp. 2d 563 (D. Del. 2006) does not involve the situation where, as here, dependent claims expressly require the “the digital data” to be subject to further processing,

such as transforms into the frequency domain and data compression. Additionally, it is a district court case, and is not controlling here. *Process Control Corp. v. HydReclaim Corp.*, 190 F.3d 1350 (Fed. Cir. 1999) also lacks the modification of the claim term in the dependent claims, as recited here. That case is inapposite as well.

The Camera Manufacturers argument (Response Brief, p. 33) concerning the prosecution history is erroneous. A statement that a transfer of digital data comprises “the digital data that have been derived from the analog data of the data transmit/receive device” is easily understood to comprise data that is straight from the analog-to-digital converter and data that is subject to additional processing, such as transformed data and compressed data. All of these types of data are “derived from the analog data of the data transmit/receive device.”

3. The Driver For The Signaled “Input/Output Device” Is Loaded Automatically.

The Camera Manufacturers are incorrect when they argue that the claims do not recite automatic selection of a driver. Response Brief, p. 31. The claims recite that, upon receiving the response from the first command interpreter, the host device communicates with the interface device using the driver indicated by the response to the inquiry:

whereupon the host device communicates with the interface device by means of the driver for the input/output device customary in a host device,

Ex. A, claim 1 (emphasis added). The word “whereupon” is the language which requires that, upon receiving the “signal,” the host device automatically uses one or more software drivers for use with the customary input/output devices to communicate with the interface device. The

Camera Manufacturers' argument that this element need not be interpreted is wrong.³ Response Brief, p. 30. The Camera Manufacturers cannot ignore the word "whereupon."

4. "Customary" Modifies "Input/Output Device" and "Storage Device," Not "Driver."

A "driver" for an input/output device customary in a host device, or for a storage device customary in a host device, means a software driver that is normally used by the computer to communicate with the customary hardware device. The software driver itself need not be "customary" because that adjective describes the hardware input/output device, not the software driver.

The Camera Manufacturers are incorrect when they argue that "customary in a host device" modifies "drivers." The Camera Manufacturers' argument is based on flawed grammar. The Federal Circuit has applied the following rule to both statutory construction and interpretation of prior art:

Referential and qualifying words and phrases, where no contrary intention appears, refer solely to the last antecedent, which consists of "the last word, phrase, or clause that can be made an antecedent without impairing the meaning of the sentence."

Anhydrides & Chemicals, Inc. v. United States, 130 F.3d 1481, 1483 (Fed. Cir. 1997) (quoting C. DALLAS SANDS, 2A SUTHERLAND STATUTORY CONSTRUCTION § 47.33 (4th ed.)) (statutory construction). "In contrast, '[w]hen a modifier is set off from a series of antecedents by a

³ The Camera Manufacturers also present an argument that refers to an amendment filed in a pending Papst patent application. Response Brief, p. 31. To abide by the Court's order prohibiting involvement in on-going patent prosecution, Papst's counsel does not respond to this argument herein. However, Papst's silence with respect to this argument should not be taken as acquiescence or agreement.

comma, the modifier should be read to apply to each of those antecedents.’” *Finisar Corp. v. The DirecTV Group, Inc.*, 523 F.3d 1323, 1336 (Fed. Cir. 2008) (interpretation of prior art).

Here, the phrase at issue is: “whereupon the host device communicates with the interface device by means of the driver for the input/output device customary in a host device.” Like in *Anhydrides*, the modifier “customary in a host device” refers solely to the last antecedent, “input/output device.” Unlike *Finisar*, the modifier is not set off from a series of antecedents by a comma. Applying these two cases, “driver” is not modified by “customary in a host device.”

This grammatical construction comports with additional claim language. For example, claim 1 of the ‘399 patent also recites, in part, “signals to the host device that it is an input/output device customary in a host device” In this phrase, “customary in a host device” unambiguously modifies “input/output device,” and there is no recitation of a “driver” at all in this phrase. For consistency in claim construction, the Court should construe “customary in a host device” to modify “input/output device,” and not “driver.”

The Camera Manufacturers also point to two dictionaries with respect to its arguments concerning the term “driver.” However, the Camera Manufacturers provide no evidence as to why one of ordinary skill in the art would consider one of the several definitions relevant, and disregard others. For example, one of the dictionaries cited by the Camera Manufacturers provides four different definitions for driver:

device driver (1) (computer graphics) The software that translates device-independent commands into device-specific commands.

(2) The software responsible for managing low-level I/O operations for a particular hardware device or set of devices. Contains all the device-specific code necessary to communicate with a device and provides a standard interface to the rest of the system. *See also*: firmware device driver; operating system device driver.

(3) A program that runs on the host and manages the sending and receiving of information from the peripheral. The driver utilizes the link level interface defined in this standard to communicate data between the application program and the peripheral personality.

(4) A software component that permits a system to control and communicate with a peripheral device. *See also:* printer driver; disk driver.

Exhibit H to the Response Brief. The Camera Manufacturers provide no rhyme or reason as to how these definitions relate to the technology discussed in the patents in suit. In particular, there is no evidence from the Camera Manufacturers as to which of the definitions (if any) would be considered relevant by a person of ordinary skill in the art after reading the patents at issue.

The Camera Manufacturers are wrong when they argue that the dictionary defines a software driver as something that “must perform the function of controlling a device.” Response Brief, p. 25 (emphasis added). The first three entries (out of a total of four) do not even mention the word “control.” These definitions as a group, therefore, strongly suggest the opposite of the Camera Manufacturers’ argument; e.g., that “control” is possible but not necessary.

Finally, construing the term driver to require some sort of control over a peripheral does not help construe the claims. In particular, the Camera Manufacturers provide no explanation of what they mean by “control.” The technical dictionary THE IEEE STANDARD DICTIONARY OF ELECTRICAL AND ELECTRONICS TERMS has several pages of definitions relating to the word “control.” Ex. F, pp 212-220.

Rather than try to sort out the conflicting dictionary definitions, the Court should consider the Declaration of Dr. Locke. Dr. Douglass Locke read the patents at issue provided the

following explanation of how a person of skill in the art would understand the term “driver” in the context of the patents in suit:

12. Certain computer programs are written for the purpose of allowing high-level software, such as Adobe Photoshop, or an operating system’s file browser, to talk to (and listen to) hardware, such as a hard disk drive. These programs are called “device drivers,” or simply “drivers” as applied to computer software. A driver **translates generic commands** (such as to “read” or “write” a file) from **high level** computer programs **into a sequence of very specific commands** that a particular hardware device can understand (such as “seek” or “load register”).

Locke Declaration, ¶12 (emphasis added). This evidence of how a person of ordinary skill in the art would understand the term as it is used in the patents-in-suit is more relevant to the Court’s analysis that the Camera Manufacturers’ selection of one of several dictionary definitions to the exclusion of the others.

5. The Court Should Reject The Camera Manufacturer’s Proposed Construction of “Multi-purpose Interface” As Contrary To The Specification.

There is no support for the Camera Manufacturers’ erroneous attempt to limit “multi-purpose interface” to interfaces which connect to devices having “more than one purpose.” Response Brief, p. 21. A multi-purpose interface may connect to multiple devices. However, there is no requirement that each device also have multiple purposes.

The Camera Manufacturers cite to two portions of the ‘399 patent as “describing multi-purpose interfaces as being interfaces such as SCSI that are configured to connect to and communicate with multiple types of devices having different functions.” Response Brief, p. 21. However, neither cited portion describes anything close to what is alleged by the Camera Manufacturers. What the ‘399 patent really says is reproduced below:

On the one hand, communication between the computer and the interface takes place by means of a host device-specific BIOS program or by means

of a driver program which is matched to the multi-purpose interface and which could be regarded as a "device-specific driver". On the other hand, the BIOS program or a corresponding multi-purpose interface program which operates one of the common input/output interfaces in host systems is therefore present in all host systems so that the interface device according to the present invention is host device-independent.

‘399 Patent, col. 5, lines 22-32

As described above, communication between the host device and the multi-purpose interface can take place not only via drivers for input/output device customary in a host device which reside in the BIOS system of the host device but also via specific interface drivers which, in the case of SCSI interfaces, are known as multi-purpose interface ASPI (advanced SCSI programming interface) drivers. This ASPI driver, which can also be referred to as an ASPI manager, is specific to a special SCSI host adapter, i.e. to a special multi-purpose interface, and is normally included by the manufacturer of the multi-purpose interface. Generally speaking, this multi-purpose interface driver has the task of moving precisely specified SCSI commands from the host system program to the host system SCSI adapter.

‘399 Patent, col. 11, lines 9-22

Contrary to the erroneous characterization by the Camera Manufacturers, there is nothing in these passages even suggesting that each device attached to a multi-purpose interface has “more than one purpose.” Furthermore, the Camera Manufacturers have not provided any evidence as to what one of ordinary skill in the art would understand these passages to mean.

The Camera Manufacturers also err when they argue that: “The modifier ‘specific’ is used in the patents-in-suit to refer to the fact that driver is not a general driver or one which is customary in the host device, but rather one that is developed for the particular multi-purpose interface employed by the host device.” Response Brief, p. 29. The Camera Manufacturers also err when they argue that the “‘specific driver’ must be a complete set of software routines that

have overall functionality of controlling a device.” Response Brief, p. 30. These arguments are incorrect because they are opposite of what is taught in additional examples in the specification:

Recently however drivers for multi-purpose interfaces can **also already be integrated in the BIOS system of the host device** as, alongside classical input/output interfaces, multi-purpose interfaces are becoming increasingly common in host devices. **It is of course also possible to use BIOS routines in parallel with the specific driver software for the multi-purpose interface**, if this is desired.

Ex. A, col. 4, lines 52-59 (emphasis added). The teaching that the specific drivers for multi-purpose interfaces may be “integrated” in the host device refutes the Camera Manufacturer’s argument that the specific multi-purpose interface must be an added driver. Also, the teaching that the BIOS routines may be used in parallel with the multi-purpose interface driver refutes the Camera Manufacturers’ argument that the multi-purpose interface driver “must be a complete set of software routines.” In contrast, the specific multi-purpose interface driver may be provided with the host computer and may operate with other drivers.

6. **The Camera Manufacturers Err When Arguing That “In” Means “Inside.”**

The Camera Manufacturers err when they argue that “input/output device customary in a host device” means “normally present within the chassis of most commercially available computers at the time of the invention.” Response Brief, p. 28. This proposed construction is without support.

The preferred embodiment of the invention involves a bus which may be either internal or *external*, i.e., a SCSI bus. External SCSI devices were well known and used at the time of the invention. Common external SCSI devices include hard disk drives, CD ROM drives, and scanners. Additionally, the examples given in the ‘399 patent of devices “customary in a host

device” include external devices, such as printers. Contrary to the argument of the Camera Manufacturers (Response Brief, p. 28), it is appropriate to construing the phrase “customary in a host device” as a complete phrase, and as it is used in the patent, and this does rendering any terms “superfluous.”

7. Simulating The Appearance Of A Storage Device Is Readily Discernable From Claim 1 of The ‘449 Patent.

Regarding claim 1 of ‘449 patent, the term “simulating a virtual file system to the host” is readily discernable, and the Camera Manufacturers provide no evidence to the contrary. When a “claim is subject to construction, i.e., it is not insolubly ambiguous, it is not invalid for indefiniteness.” *Bancorp Services LLC v. Hartford Life Insurance Co.*, 359 F.3d 1367, 1372 (Fed. Cir. 2004). The Federal Circuit explained that difficulty in construing a claim, or a difference of opinion as to its meaning, will not render a claim invalid:

[I]f the meaning of the claim is discernible, "even though the task may be formidable and the conclusion may be one over which reasonable persons will disagree, we have held the claim sufficiently clear to avoid invalidity on indefiniteness grounds." *Exxon Research & Eng'g Co. v. United States*, 265 F.3d 1371, 1375 (Fed. Cir. 2001).

Bancorp, 359 F.3d at 1372. In this regard, the statutory presumption of validity is sustained. *Id.*

In *Bancorp*, the Federal Circuit reversed the district court’s conclusion of invalidity due to indefiniteness. In *Bancorp*, the claim term "surrender value protected investment credits" was not expressly defined in the patents and was not found in any industry publications. *Id.* “Nonetheless, the components of the term have well-recognized meanings, which allow the reader to infer the meaning of the entire phrase with reasonable confidence.” *Id.* The Federal Circuit found the claim language amenable to construction, and reversed the judgment of invalidity.

Additionally, the Federal Circuit faulted the district court for failing to consider expert testimony that the claim terms were understandable by one of ordinary skill in the art. *Id.* at 1375 (“It was therefore error for the court to decline to consider Mr. Mylnechuk’s evidence regarding the meaning of a term used in connection with stable value protected investments.”).

Here, as in *Bancorp*, the meaning of the phrase as a whole is discernable. Dr. Locke provided his opinion concerning the meaning of “virtual file system”

32. A person of ordinary skill in the art would understand the term “virtual file system” to mean a file system that appears to a computer in the same way that a file system on a conventional hard disk would appear, even though the rotating discs of a conventional hard disk are not present.

Locke Decl. ¶32. This evidentiary declaration is not contradicted by any evidence from the Camera Manufacturers. Additionally, the specification contains examples of simulating a hard disk drive, including a file system. Ex. B, Col. 5, lines 35-44. A person of ordinary skill in the art would understand the specification to describe how to simulate a virtual file system, i.e., the interface device responds to the host computer with a file system and directory structure of the type that would be found on a conventional hard disk, even though the physical structure of a conventional hard disk is not present on the interface device. Based on this, the Court should conclude that the meaning of claim 1 of the ‘449 patent is discernable, (e.g., simulating a disk drive with such a file system) and the claim is not invalid.

F. Dependent Claims

1. A “Hard Disk” Is A Particular Type Of Input/Output Device.

The Camera Manufacturers incorrectly argue that claim 2 of the ‘399 patent does not need any claim construction. Their argument is based on the false premise that terms appearing in claim 1 and claim 2 can be construed and applied without considering how they are used in

claim 2. E.g., *Phillips*, 415 F.3d at 1314-15 (“For example, the presence of a dependent claim that adds a particular limitation gives rise to a presumption that the limitation in question is not present in the independent claim.”). Moreover, not all of the terms appearing in claim 2 are construed with respect to claim 1.

The Camera Manufacturers do not dispute that a hard disk is one of the examples of an input output device that may be identified in the signal from the interface device. Ex. A, col. 4, lines 34-36. Additionally, the Camera Manufacturers do not dispute that the term “hard disk drive” is well known in the art and should be given its ordinary meaning. Ex. C, ¶18. Accordingly, it is appropriate to construe Claim 2 (but not claim 1) as requiring the interface device to send a signal in response to the inquiry from the computer that indicates to the computer that the interface device is a particular type of input/output device, i.e., a hard disk drive. It also is appropriate to construe claim 2 to require that the computer communicate with the interface device using a driver for a particular type of input/output device, i.e., a hard disk drive. This construes the terms “hard disk driver” and “signal” as those terms are used in claim 2, and is not “rewriting” the claim. In this regard, *Chef America, Inc. v. Lamb-Weston, Inc.*, 358 F.3d 1371 (Fed. Cir. 2004) is inapposite.

Moreover, Papst’s construction does not “delete” any claim limitation. Response Brief, p. 35. In particular, it does not delete the term “customary.” Hard disk drives are one of the examples given in the patent as an input/output device customary in a host device. Accordingly, the express recitation that the input/output device comprises a hard disk drive satisfies the limitation that the input/output device is one which is customary in the host device.

2. The “Data Buffer” Stores Information For Later Retrieval.

The Camera Manufacturers erroneously argue that construing the term “buffer” in claim 3 of the ‘399 patent to further define the memory in claim 1 somehow makes claim 3 the same scope as claim 1. The Camera Manufacturers misunderstand the doctrine of claim differentiation. *Phillips*, 415, F.3d at 1314-15 (“the presence of a dependent claim that adds a particular limitation gives rise to a presumption that the limitation in question is not present in the independent claim.”).

Claim 3 depends from claim 1, and further defines the memory that is recited in independent claim 1:

An interface device according to claim 1, wherein **the memory means comprises a buffer** to buffer data to be transferred between the data transmit/receive device and the host device.

Ex. A, claim 3. The “memory means” refers to the “memory” recited in claim 1. The “memory” in claim 1 does not require a buffer, and in claim 3 it does. Because claim 3 further defines the memory, is not the same scope as claim 1, and there is no “violation” of the doctrine of claim differentiation. Response Brief, p. 36. On the contrary, Papst’s construction preserves claim differentiation.

The Camera Manufacturers’ reliance on the Oxford Dictionary of Computing is misplaced. A more appropriate definition is found in the IEEE dictionary:

buffer (1) (buffer storage) (supervisory control, data acquisition, and automatic control) A device in which data are stored temporarily, in the course of transmission from one point to another; used to compensate for a difference in the flow of data, or time of occurrence of events, when transmitting data from one device to another.

THE IEEE STANDARD DICTIONARY OF ELECTRICAL AND ELECTRONICS TERMS, p. 113. Ex. F (bold emphasis in original, underlining added).⁴ As used in this definition, “buffer” is not limited to compensating for a difference in the flow of data. Instead, an alternate meaning is that the buffer may be used to compensate for a difference in “**time of occurrence of events.**” This second meaning is the sense used in the patent specification: “a data buffer can be implemented in the memory means 14 to permit **independence in terms of time** of the data transmit/receive device attached to the second connecting device from the host device attached to the first connecting device.” Ex. A col. 9, lines 8-14 (emphasis added). Moreover, there is no time limitation provided in the specification. The proposed construction of the Camera Manufacturers should be rejected as incompatible with the specification and with the ordinary meaning of the word “buffer.”

3. The Camera Manufacturers Misconstrue “Virtual Files.”

The Declaration of Dr. Locke is un rebutted. Virtual files should be construed to mean files which appear to be stored on an emulated disk drive, yet which are not actually on a rotating disc. Ex. C, ¶31. Moreover, the Camera Manufacturers err when they argue that the term “virtual files” excludes files that are stored in memory, and then made to appear as if they were stored on a hard disk drive. The specification explains that various files may be stored in “memory means 14,” including the operating system for the interface device, configuration files, batch files and executable files. Ex. A, col. 5, lines 26-27; col. 6, lines 23-29, 32-36, 50-60. Indeed, the patent discusses the “option of storing any files in agreed formats in the memory

⁴ There are six other definitions in the IEEE dictionary, but the others do not indicate relevance to “data acquisition,” as does the first definition.

means 14 of the interface device 10. . .” Ex. A, col. 6, lines 50-52. The specification also notes that the memory means 14 may comprise EPROM, EEPROM, or RAM (the digital cameras in suit use EEPROM to store pictures for later retrieval by a computer).

In this regard, non-asserted claim 9 (reciting that “the **virtual files comprise batch files or executable files** for the microprocessor means **which are stored in the interface device . . .**”) is well supported by the specification. Ex. A, claim 9 (emphasis added). The term “virtual file” must be construed consistently with claim 9, which covers virtual files that are actually stored in the interface device, such as in the memory of the interface device. The Camera Manufacturers’ claim construction should be rejected as rendering claim 9 meaningless. See, *Cytologix*, 424 F.3d at 1173-74 (reversing construction of base claim which would have rendered dependent claim meaningless).

The Camera Manufacturers make an incorrect argument concerning the purported “crux” of the invention. Response Brief, p. 38. However, there is no legally recognized “gist” or “heart” of an invention that would allow certain embodiments in the specification to be elevated over the claims as finally worded. E.g., *Aro Mfg. Co. v. Convertible Top Replacement Co.*, 365 U.S. 336, 344 (1961) (“[I]f anything is settled in patent law, it is that the combination patent covers only the totality of the elements in the claim and that no element, separately viewed, is within the grant. The basic fallacy of respondent’s position is that it requires the ascribing to one element of the patented combination the status of patented invention itself.”).

4. The Signaled Hard Disk Drive Refers To The Indicated Presence Of A Hard Disk Drive.

The Camera Manufacturers misunderstand both the claim language regarding the “signaled hard disk drive” and Papst’s construction of that term. The interface device is real.

The interface device “sends a signal . . . which signals to the host device that it is a input/output device.” Ex. A, claim 1. The signal further “indicates to the host device that the host device is communicating with a hard disk.” Ex. A, claim 2. Claim 7 depends from claim 2, which depends from claim 1, and consequently includes these elements. The term “signaled hard disk drive,” therefore, refers not to an actual hard disk drive, but to the indicated presence of a hard disk drive, as indicated by the signal recited in claim 2.

5. Claim 14 Of The ‘399 Patent Has Sufficient Antecedent Basis.

The Camera Manufacturers’ incorrectly argue that the claim phrases “the usual driver for the input/output device” and “the usual driver for the storage device” are indefinite. The argument fails because it elevates form over substance. “When the meaning of the claim would reasonably be understood by persons of ordinary skill when read in light of the specification, the claim is not subject to invalidity upon departure from the protocol of ‘antecedent basis.’” *Energizer Holdings, Inc. v. International Trade Comm’n*, 435 F.3d 1366, 1370 (Fed. Cir. 2006); see also, MPEP §2173.05 (“Obviously, however, the failure to provide explicit antecedent basis for terms does not always render a claim indefinite. If the scope of a claim would be reasonably ascertainable by those skilled in the art, then the claim is not indefinite.”) (Ex. J to the Response Brief). Thus, the question is not whether the protocol of “antecedent basis” is followed, but rather, whether the meaning of the claim can be reasonably ascertained.

Claim 14 is a method claim, and does not share the same preamble as the device claims discussed earlier in this brief. The preamble for claim 14 recites:

A method of communication between a host device, **which comprises drivers for input/output devices customary in a host device** and a multi-purpose interface, and a data transmit/receive device, the data transmit/receive device being arranged for providing analog data, via an interface device, comprising:

Ex. A, claim 14. Thus, the host device is defined as including drivers. The phrase at issue appears later in the body of the claim:

regardless of the type of the data transmit/receive data attached to the second connecting device of the interface device, responding to the inquiry from the host device by the interface device in such a way that it is an input/output device customary in a host device, whereupon the host device communicates with the interface device by **means of the usual driver for the input/output device**, and

Ex. A, claim 14. Here, the phrase “the usual driver for the input/output device” refers to one of the “drivers for input/output devices customary in a host device” set forth in the preamble. Claim 14 of the ‘399 patent and its counterpart method claim in the ‘449 patent, claim 18, are not indefinite or invalid.

III. CONCLUSION

For the reasons set forth above, and for the reasons set forth in Papst’s Markman Brief, Papst Licensing requests that the Court construe the claims at issue as indicated in the Appendix to Papst’s Markman Brief and to reject the erroneous constructions of the Camera Manufacturers.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing PAPST LICENSING'S REPLY MARKMAN BRIEF was served on this the 30th day of July, 2008 upon the attorneys for the Camera Manufacturers through the United States District Court for the District of Columbia ECF System unless otherwise noted as follows:

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(12) **United States Patent**
Tasler

(10) **Patent No.:** US 6,470,399 B1
(45) **Date of Patent:** Oct. 22, 2002

(54) FLEXIBLE INTERFACE FOR COMMUNICATION BETWEEN A HOST AND AN ANALOG I/O DEVICE CONNECTED TO THE INTERFACE REGARDLESS THE TYPE OF THE I/O DEVICE

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Primary Examiner—Thomas Lee

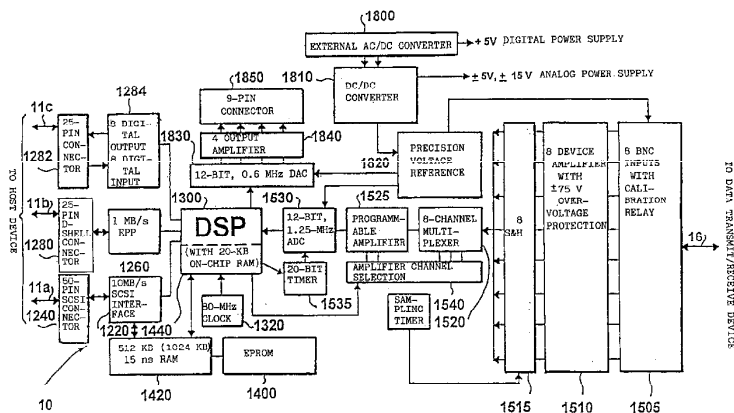
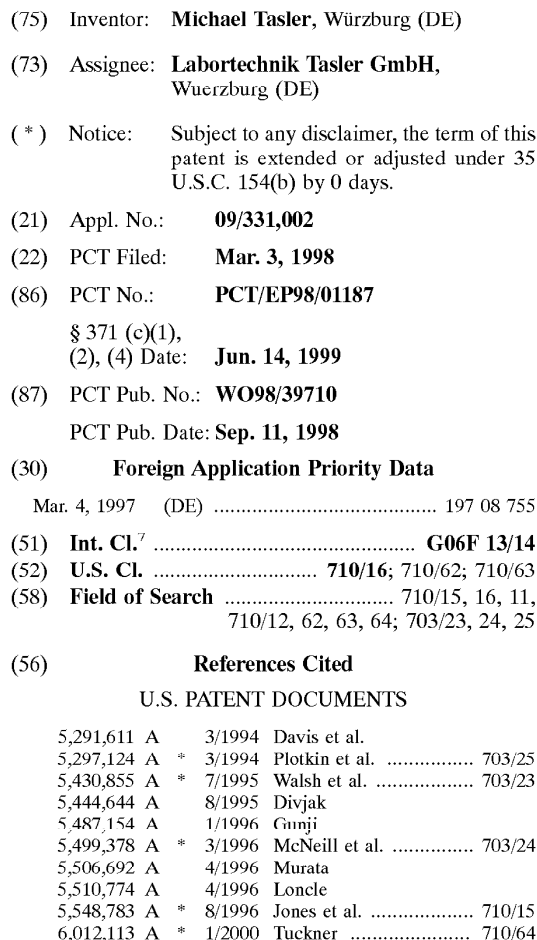
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(57) **ABSTRACT**

An interface device (10) provides fast data communication between a host device with input/output interfaces and a data transmit/receive device, wherein the interface device (10) comprises a processor means (13), a memory means (14), a first connecting device (12) for interfacing the host device with the interface device, and a second connecting device (15) for interfacing the interface device (10) with the data transmit/receive device. The interface device (10) is configured by the processor means (13) and the memory means (14) in such a way that, when receiving an inquiry from the host device via the first connecting device (12) as to the type of a device attached to the host device, regardless of the type of the data transmit/receive device, the interface device sends a signal to the host device via the first connecting device (12) which signals to the host device that it is communicating with an input/output device.

15 Claims, 2 Drawing Sheets



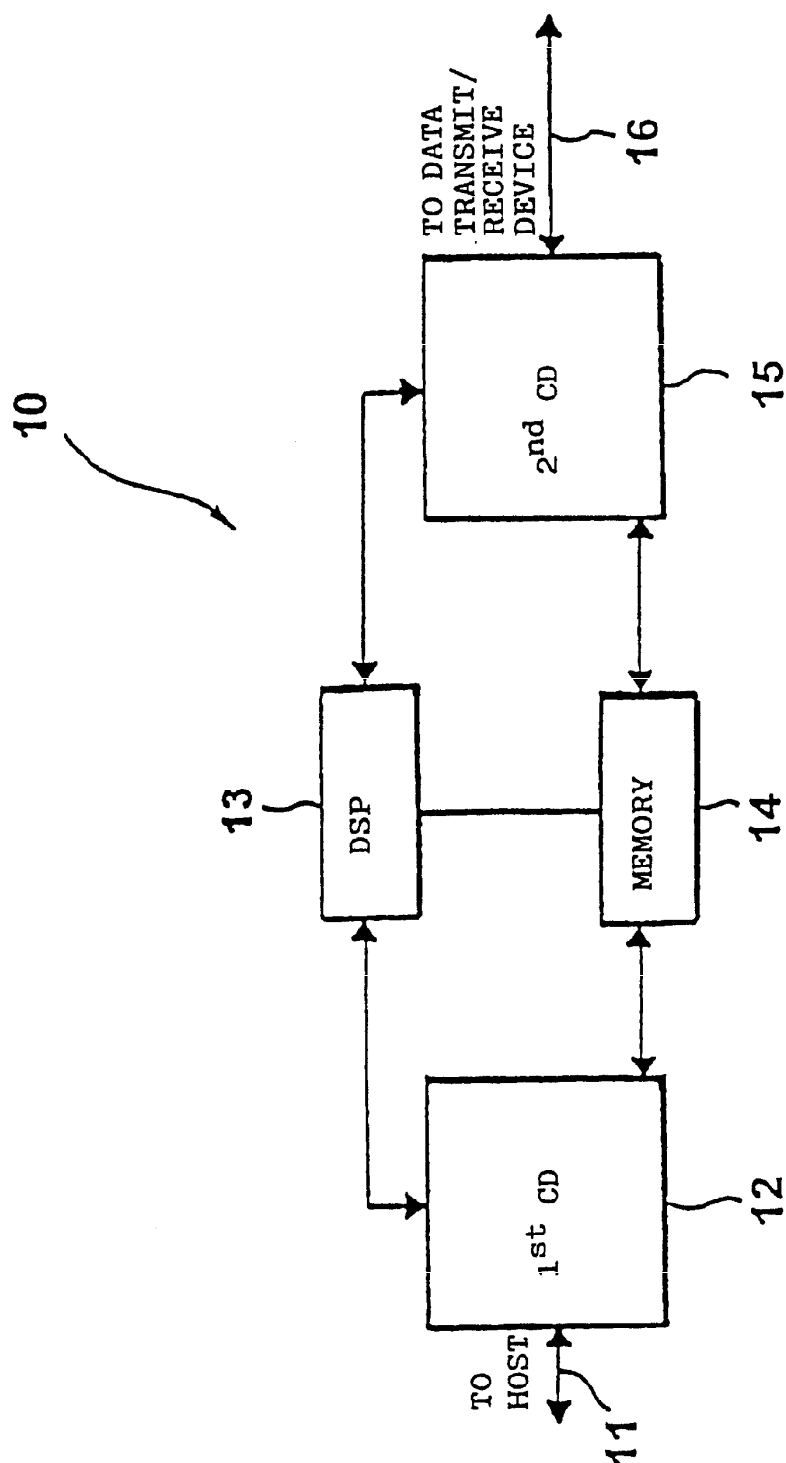


FIG. 1

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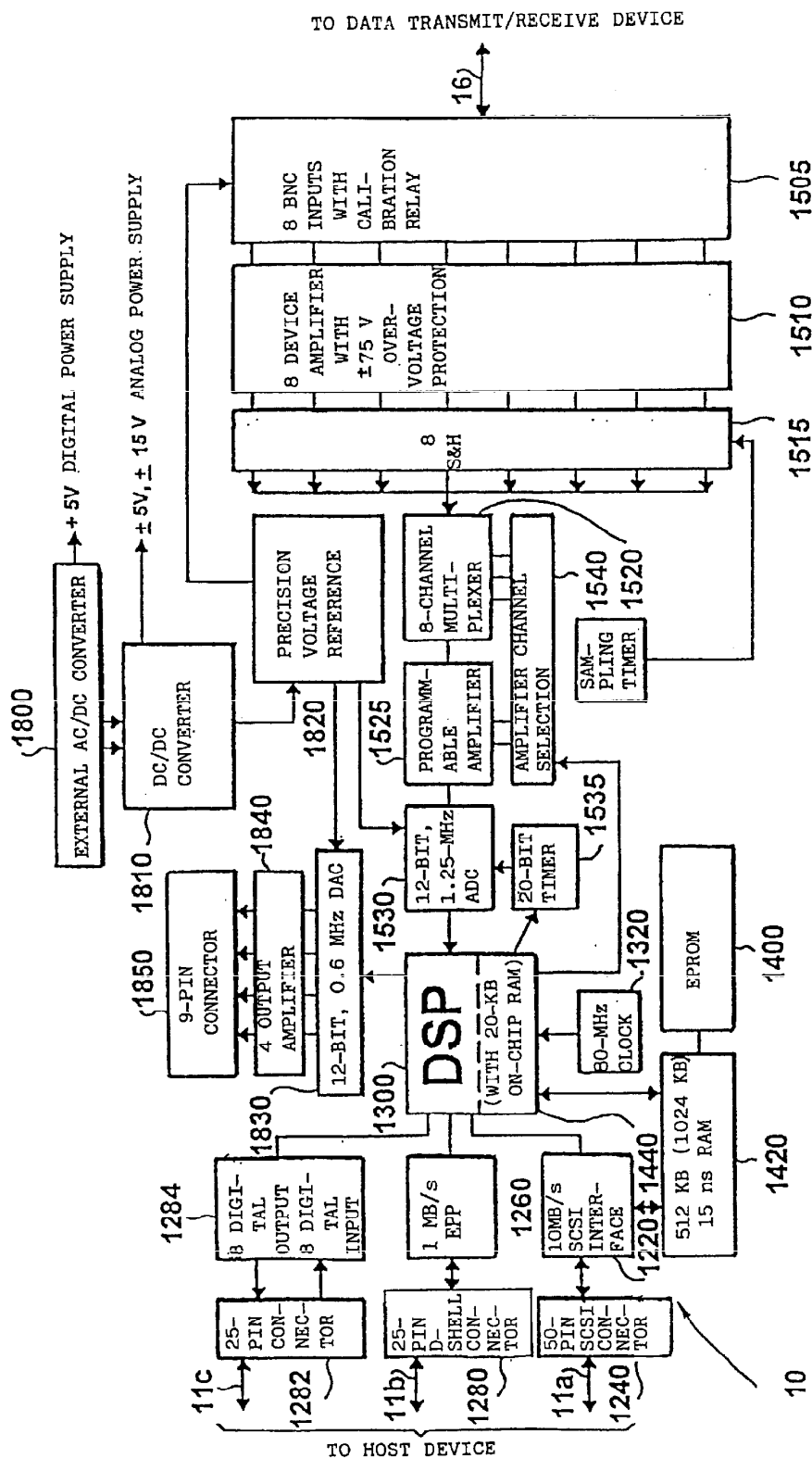


FIG. 2

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FLEXIBLE INTERFACE FOR COMMUNICATION BETWEEN A HOST AND AN ANALOG I/O DEVICE CONNECTED TO THE INTERFACE REGARDLESS THE TYPE OF THE I/O DEVICE

FIELD OF THE INVENTION

The present invention relates to the transfer of data and in particular to interface devices for communication between a computer or host device and a data transmit/receive device from which data is to be acquired or with which two-way communication is to take place.

BACKGROUND OF THE INVENTION

Existing data acquisition systems for computers are very limited in their areas of application. Generally such systems can be classified into two groups.

In the first group host devices or computer systems are attached by means of an interface to a device whose data is to be acquired. The interfaces of this group are normally standard interfaces which, with specific driver software, can be used with a variety of host systems. An advantage of such interfaces is that they are largely independent of the host device. However, a disadvantage is that they generally require very sophisticated drivers which are prone to malfunction and which limit data transfer rates between the device connected to the interface and the host device and vice versa. Further, it is often very difficult to implement such interfaces for portable systems and they offer few possibilities for adaptation with the result that such systems offer little flexibility.

The devices from which data is to be acquired cover the entire electrical engineering spectrum. In a typical case, it is assumed that a customer who operates, for example, a diagnostic radiology system in a medical engineering environment reports a fault. A field service technician of the system manufacturer visits the customer and reads system log files generated by the diagnostic radiology system by means of a portable computer or laptop for example. If the fault cannot be localized or if the fault is intermittent, it will be necessary for the service technician to read not only an error log file but also data from current operation. It is apparent that in this case fast data transfer and rapid data analysis are necessary.

Another case requiring the use of an interface could be, for example, when an electronic measuring device, e.g. a multimeter, is attached to a computer system to transfer the data measured by the multimeter to the computer. Particularly when long-term measurements or large volumes of data are involved it is necessary for the interface to support a high data transfer rate.

From these randomly chosen examples it can be seen that an interface may be put to totally different uses. It is therefore desirable that an interface be sufficiently flexible to permit attachment of very different electrical or electronic systems to a host device by means of the interface. To prevent operator error, it is also desirable that a service technician is not required to operate different interfaces in different ways for different applications but that, if possible, a universal method of operating the interface be provided for a large number of applications.

To increase the data transfer rates across an interface, the route chosen in the second group of data acquisition systems for the interface devices was to specifically match the

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interface very closely to individual host systems or computer systems. The advantage of this solution is that high data transfer rates are possible. However, a disadvantage is that the drivers for the interfaces of the second group are very closely matched to a single host system with the result that they generally cannot be used with other host systems or their use is very ineffective. Further, such types of interface have the disadvantage that they must be installed inside the computer casing to achieve maximum data transfer rates as they access the internal host bus system. They are therefore generally not suitable for portable host systems in the form of laptops whose minimum possible size leaves little internal space to plug in an interface card.

DESCRIPTION OF PRIOR ART

A solution to this problem is offered by the interface devices of Iotech (business address: 25971 Cannon Road, Cleveland, Ohio 44146, USA) which are suitable for laptops such as the WaveBook/512 (registered trademark). The interface devices are connected by means of a plug-in card, approximately the size of a credit card, to the PCMCIA interface which is now a standard feature in laptops. The plug-in card converts the PCMCIA interface into an interface known in the art as IEEE 1284. The said plug-in card provides a special printer interface which is enhanced as regards the data transfer rate and delivers a data transfer rate of approximately 2 MBps as compared with a rate of approx. 1 MBps for known printer interfaces. The known interface device generally consists of a driver component, a digital signal processor, a buffer and a hardware module which terminates in a connector to which the device whose data is to be acquired is attached. The driver component is attached directly to the enhanced printer interface thus permitting the known interface device to establish a connection between a computer and the device whose data is to be acquired.

In order to work with the said interface, an interface-specific driver must be installed on the host device so that the host device can communicate with the digital signal processor of the interface card. As described above, the driver must be installed on the host device. If the driver is a driver developed specifically for the host device, a high data transfer rate is achieved but the driver cannot be easily installed on a different host system. However, if the driver is a general driver which is as flexible as possible and which can be used on many host devices, compromises must be accepted with regard to the data transfer rate.

Particularly in an application for multi-tasking systems in which several different tasks such as data acquisition, data display and editing are to be performed quasi-simultaneously, each task is normally assigned a certain priority by the host system. A driver supporting a special task requests the central processing system of the host device for processor resources in order to perform its task. Depending on the particular priority assignment method and on the driver implementation, a particular share of processor resources is assigned to a special task in particular time slots. Conflicts arise if one or more drivers are implemented in such a way that they have the highest priority by default, i.e. they are incompatible, as happens in practice in many applications. It may occur that both drivers are set to highest priority which, in the worst case, can result in a system crash.

EP 0685799 A1 discloses an interface by means of which several peripheral devices can be attached to a bus. An interface is connected between the bus of a host device and various peripheral devices. The interface comprises a finite

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state machine and several branches each of which is assigned to a peripheral device. Each branch comprises a data manager, cycle control, user logic and a buffer. This known interface device provides optimal matching between a host device and a specific peripheral device.

The specialist publication IBM Technical Disclosure Bulletin, Vol. 38, No. 05, page 245; "Communication Method between Devices through FDD Interface" discloses an interface which connects a host device to a peripheral device via a floppy disk drive interface. The interface consists in particular of an address generator, an MFM encoder/decoder, a serial/parallel adapter and a format signal generator. The interface makes it possible to attach not only a floppy disk drive but also a further peripheral device to the FDD host controller of a host device. The host device assumes that a floppy disk drive is always attached to its floppy disk drive controller and communication is initiated if the address is correct. However, this document contains no information as to how communication should be possible if the interface is connected to a multi-purpose interface instead of to a floppy disk drive controller.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an interface device for communication between a host device and a data transmit/receive device whose use is host device-independent and which delivers a high data transfer rate.

In accordance with a first aspect of the present invention, this object is met by an interface device for communication between a host device, which comprises drivers for input/output devices customary in a host device and a multi-purpose interface, and a data transmit/receive device comprising: a processor; a memory; a first connecting device for interfacing the host device with the interface device via the multi-purpose interface of the host device; and a second connecting device for interfacing the interface device with the data transmit/receive device, wherein the interface device is configured by the processor and the memory in such a way that the interface device, when receiving an inquiry from the host device as to the type of a device attached to the multi-purpose interface of the host device, sends a signal, regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, to the host device which signals to the host device that it is an input/output device customary in a host device, whereupon the host device communicates with the interface device by means of the driver for the input/output device customary in a host device.

In accordance with a second aspect of the present invention, this object is met by an interface device for communication between a host device, which comprises a multi-purpose interface and a specific driver for this interface, and a data transmit/receive device comprising: a processor; a memory; a first connecting device for interfacing the host device with the interface device via the multi-purpose interface of the host device; and a second connecting device for interfacing the interface device with the data transmit/receive device, wherein the interface device is configured using the processor and the memory in such a way that the interface device, when receiving an inquiry from the host device as to the type of a device attached at the multi-purpose interface of the host device, sends a signal, regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, to the host device which signals to the host device that it is an input/output device customary in a host device,

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whereupon the host device communicates with the interface device by means of the specific driver for the multi-purpose interface.

In accordance with a third aspect of the present invention, this object is met by a method of communication between a host device, which comprises drivers for input/output devices customary in a host device and a multi-purpose interface, and a data transmit/receive device via an interface device comprising the steps of interfacing of the host device with a first connecting device of the interface device via the multi-purpose interface of the host device; interfacing of the data transmit/receive device with a second connecting device of the interface device; inquiring by the host device at the interface device as to the type of device to which the multi-purpose interface of the host device is attached; regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, responding to the inquiry from the host device by the interface device in such a way that it is an input/output device customary in a host device, whereupon the host device communicates with the interface device by means of the usual driver for the input/output device.

The present invention is based on the finding that both a high data transfer rate and host device-independent use can be achieved if a driver for an input/output device customary in a host device, normally present in most commercially available host devices, is utilized. Drivers for input/output devices customary in a host device which are found in practically all host devices are, for example, drivers for hard disks, for graphics devices or for printer devices. As however the hard disk interfaces in common host devices which can be, for example, IBM PCs, IBM-compatible PCs, Commodore PCs, Apple computers or even workstations, are the interfaces with the highest data transfer rate, the hard disk driver is utilized in the preferred embodiment of the interface device of the present invention. Drivers for other storage devices such as floppy disk drives, CD-ROM drives or tape drives could also be utilized in order to implement the interface device according to the present invention.

As described in the following, the interface device according to the present invention is to be attached to a host device by means of a multi-purpose interface of the host device which can be implemented, for example, as an SCSI interface or as an enhanced printer interface. Multi-purpose interfaces comprise both an interface card and specific driver software for the interface card. The driver software can be designed so that it can replace the BIOS driver routines. Communication between the host device and the devices attached to the multi-purpose interface then essentially takes place by means of the specific driver software for the multi-purpose interface and no longer primarily by means of BIOS routines of the host device. Recently however drivers for multi-purpose interfaces can also already be integrated in the BIOS system of the host device as, alongside classical input/output interfaces, multi-purpose interfaces are becoming increasingly common in host devices. It is of course also possible to use BIOS routines in parallel with the specific driver software for the multi-purpose interface, if this is desired.

The interface device according to the present invention comprises a processor means, a memory means, a first connecting device for interfacing the host device with the interface device, and a second connecting device for interfacing the interface device with the data transmit/receive device. The interface device is configured by the processor means and the memory means in such a way that the interface device, when receiving an inquiry from the host

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device via the first connecting device as to the type of a device attached to the host device, sends a signal, regardless of the type of the data transmit/receive device, to the host device via the first connecting device which signals to the host device that it is communicating with an input/output device. The interface device according to the present invention therefore simulates, both in terms of hardware and software, the way in which a conventional input/output device functions, preferably that of a hard disk drive. As support for hard disks is implemented as standard in all commercially available host systems, the simulation of a hard disk, for example, can provide host device-independent use. The interface device according to the present invention therefore no longer communicates with the host device or computer by means of a specially designed driver but by means of a program which is present in the BIOS system (Basic Input/Output System) and is normally precisely matched to the specific computer system on which it is installed, or by means of a specific program for the multi-purpose interface. Consequently, the interface device according to the present invention combines the advantages of both groups. On the one hand, communication between the computer and the interface takes place by means of a host device-specific BIOS program or by means of a driver program which is matched to the multi-purpose interface and which could be regarded as a "device-specific driver". On the other hand, the BIOS program or a corresponding multi-purpose interface program which operates one of the common input/output interfaces in host systems is therefore present in all host systems so that the interface device according to the present invention is host device-independent.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, preferred embodiments of the present invention will be explained in more detail with reference to the drawings enclosed, in which:

FIG. 1 shows a general block diagram of the interface device according to the present invention; and

FIG. 2 shows detailed block diagram of an interface device according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows a general block diagram of an interface device 10 according to the present invention. A first connecting device 12 of the interface device 10 can be attached to a host device (not shown) via a host line 11. The first connecting device is attached both to a digital signal processor 13 and to a memory means 14. The digital signal processor 13 and the memory means 14 are also attached to a second connecting device 15 by means of bidirectional communication lines (shown for all lines by means of two directional arrows). The second connecting device can be attached by means of an output line 16 to a data transmit/receive device which is to receive data from the host device or from which data is to be read, i.e. acquired, and transferred to the host device. The data transmit/receive device itself can also communicate actively with the host device via the first and second connecting device, as described in more detail in the following.

Communication between the host system or host device and the interface device is based on known standard access commands as supported by all known operating systems (e.g. DOS, Windows, Unix). Preferably, the interface device

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according to the present invention simulates a hard disk with a root directory whose entries are "virtual" files which can be created for the most varied functions. When the host device system with which the interface device according to the present invention is connected is booted and a data transmit/receive device is also attached to the interface device 10, usual BIOS routines or multi-purpose interface programs issue an instruction, known by those skilled in the art as the INQUIRY instruction, to the input/output interfaces in the host device. The digital signal processor 13 receives this inquiry instruction via the first connecting device and generates a signal which is sent to the host device (not shown) again via the first connecting device 12 and the host line 11. This signal indicates to the host device that, for example, a hard disk drive is attached at the interface to which the INQUIRY instruction was sent. Optionally, the host device can send an instruction, known by those skilled in the art as "Test Unit Ready", to the interface device to request more precise details regarding the queried device.

Regardless of which data transmit/receive device at the output line 16 is attached to the second connecting device, the digital signal processor 13 informs the host device that it is communicating with a hard disk drive. If the host device receives the response that a drive is present, it then sends a request to the interface device 10 to read the boot sequence which, on actual hard disks, normally resides on the first sectors of the disk. The digital signal processor 13, whose operating system is stored in the memory means 14, responds to this instruction by sending to the host device a virtual boot sequence which, in the case of actual drives, includes the drive type, the starting position and the length of the file allocation table (FAT), the number of sectors, etc., known to those skilled in the art. Once the host device has received this data, it assumes that the interface device 10 according to a preferred embodiment of the present invention is a hard disk drive. In reply to an instruction from the host device to display the directory of the "virtual" hard disk drive simulated by the interface device 10 with respect to the host device, the digital signal processor can respond to the host device in exactly the same way as a conventional hard disk would, namely by reading on request the file allocation table or FAT on a sector specified in the boot sequence, normally the first writable sector, and transferring it to the host device, and subsequently by transferring the directory structure of the virtual hard disk. Further, it is possible that the FAT is not read until immediately prior to reading or storing the data of the "virtual" hard disk and not already at initialization.

In a preferred embodiment of the present invention, the digital signal processor 13, which need not necessarily be implemented as a digital signal processor but may be any other kind of microprocessor, comprises a first and a second command interpreter. The first command interpreter carries out the steps described above whilst the second command interpreter carries out the read/write assignment to specific functions. If the user now wishes to read data from the data transmit/receive device via the line 16, the host device sends a command, for example "read file xy", to the interface device. As described above, the interface device appears to the host device as a hard disk. The second command interpreter of the digital signal processor now interprets the read command of the host processor as a data transfer command, by decoding whether "xy" denotes, for example, a "real-time input" file, a "configuration" file or an executable file, whereby the same begins to transfer data from the data transmit/receive device via the second connecting device to the first connecting device and via the line 11 to the host device.

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Preferably, the volume of data to be acquired by a data transmit/receive device is specified in a configuration file described in the following by the user specifying in the said configuration file that a measurement is to last, for example, five minutes. To the host device the "real-time input" file then appears as a file whose length corresponds to the anticipated volume of data in those five minutes. Those skilled in the art know that communication between a processor and a hard disk consists of the processor transferring to the hard disk the numbers of the blocks or clusters or sectors whose contents it wishes to read. By reference to the FAT the processor knows which information is contained in which block. In this case, communication between the host device and the interface device according to the present invention therefore consists of the very fast transfer of block numbers and preferably of block number ranges because a virtual "real-time input" file will not be fragmented. If the host device now wants to read the "real-time input" file, it transfers a range of block numbers to the interface device, whereupon data commences to be received via the second connecting device and data commences to be sent to the host device via the first connecting device.

In addition to the digital signal processor instruction memory, which comprises the operating system of the digital signal processor and can be implemented as an EPROM or EEPROM, the memory means 14 can have an additional buffer for purposes of synchronizing data transfer from the data transmit/receive device to the interface device 10 and data transfer from the interface device 10 to the host device.

Preferably, the buffer is implemented as a fast random access memory or RAM buffer.

Further, from the host device the user can also create a configuration file, whose entries automatically set and control various functions of the interface device 10, on the interface device 10 which appears to the host device as a hard disk. These settings can be, for example, gain, multiplex or sampling rate settings. By creating and editing a configuration file, normally a text file which is simple to understand with little prior knowledge, users of the interface device 10 are able to perform essentially identical operator actions for almost any data transmit/receive devices which can be attached to the second connecting device via the line 16, thus eliminating a source of error arising from users having to know many different command codes for different applications. In the case of the interface device 10 according to the present invention it is necessary for users to note the conventions of the configuration file once only in order to be able to use the interface device 10 as an interface between a host device and almost any data transmit/receive device.

As a result of the option of storing any files in agreed formats in the memory means 14 of the interface device 10, taking into account the maximum capacity of the memory means, any enhancements or even completely new functions of the interface device 10 can be quickly implemented. Even files executable by the host device, such as batch files or executable files (BAT or EXE files), and also help files can be implemented in the interface device, thus achieving independence of the interface device 10 from any additional software (with the exception of the BIOS routines) of the host device. On the one hand, this avoids licensing and/or registration problems and, on the other hand, installation of certain routines which can be frequently used, for example an FFT routine to examine acquired time-domain data in the frequency domain, is rendered unnecessary as the EXE files are already installed on the interface device 10 and appear in the virtual root directory, by means of which the host device can access all programs stored on the interface device 10.

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In a preferred embodiment of the present invention in which the interface device 10 simulates a hard disk to the host device, the interface device is automatically detected and readied for operation when the host system is powered up or booted. This corresponds to the plug-and-play standard which is currently finding increasingly widespread use. The user is no longer responsible for installing the interface device 10 on the host device by means of specific drivers which must also be loaded; instead the interface device 10 is automatically readied for operation when the host system is booted.

For persons skilled in the art it is however obvious that the interface device 10 is not necessarily signed on when the computer system is powered up but that a special BIOS routine or a driver for a multi-purpose interface can also be started on the host device during current operation of the computer system in order to sign on or mount the interface device 10 as an additional hard disk. This embodiment is suitable for larger workstation systems which are essentially never powered down as they perform, e.g. mail functions or monitor processes which run continuously, for example, in multi-tasking environments.

In the interface device according to the present invention an enormous advantage is to be gained, as apparent in the embodiment described in the following, in separating the actual hardware required to attach the interface device 10 to the data transmit/receive device from the communication unit, which is implemented by the digital signal processor 13, the memory means 14 and the first connecting device 12, as this allows a plurality of dissimilar device types to be operated in parallel in identical manner. Accordingly, many interface devices 10 can be connected to a host device which then sees many different "virtual" hard disks. In addition, any modification of the specific hardware symbolized by the second connecting device 15 can be implemented essentially without changing the operation of the interface device according to the present invention. Further, an experienced user can intervene at any time on any level of the existing second connecting device by making use of the above mentioned option of creating a configuration file or adding or storing new program sections for the second connecting device.

An important advantage of the interface device 10 of the present invention is that it also permits extremely high data transfer rates by using, for data interchange, the host device-own BIOS routines which are optimized for each host device by the host device manufacturer or BIOS system manufacturer, or by using driver programs which are normally optimized and included by the manufacturers of multi-purpose interfaces. Furthermore, due to the simulation of a virtual mass storage device, the data is managed and made available in such a way that it can be transferred directly to other storage media, e.g. to an actual hard disk of the host device without, as it were, intervention of the host device processor. The only limitation to long-term data transfer at high speed is therefore imposed exclusively by the speed and the size of the mass storage device of the host device. This is the case as the digital signal processor 13 already formats the data read by the data transmit/receive device via the second connecting device 15 into block sizes suitable for a hard disk of the host device, whereby the data transfer speed is limited only by the mechanical latency of the hard disk system of the host device. At this point, it should be noted that normally data flow from a host device must be formatted in blocks to permit writing to a hard disk and subsequent reading from a hard disk, as known by those skilled in the art.

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The said data transfer rate can be increased further by setting up a direct memory access (DMA) or RAM drive in the host system. As those skilled in the art know, the setting up of a RAM drive requires processor resources of the host device, with the result that the advantage of writing the data to a hard disk drive of the host device essentially without the need for processor resources is lost.

As described above, a data buffer can be implemented in the memory means **14** to permit independence in terms of time of the data transmit/receive device attached to the second connecting device from the host device attached to the first connecting device. This guarantees error-free operation of the interface device **10** even for time-critical applications in multi-tasking host systems.

FIG. 2 shows a detailed block diagram of an interface device **10** according to the present invention.

A digital signal processor (DSP) **1300** is, in a manner of speaking, the heart of the interface device **10**. The DSP can be any DSP but preferably has a 20-MB on-chip random access memory (RAM). Certain instruction sets, for example, can be stored in the RAM already integrated in the DSP. An 80-MHz clock generator is attached to the DSP **1300** in order to synchronize the DSP. The DSP implements a fast Fourier transformation (FFT) in real time and also optional data compression of the data to be transferred from the data transmit/receive device to the host device in order to achieve greater efficiency and to permit interoperability with host devices which have a smaller memory.

In the preferred embodiment of the interface device **10** shown in FIG. 2, the first connecting device **12** of FIG. 1 contains the following components: an SCSI interface **1220** and a 50-pin SCSI connector **1240** for attachment to an SCSI interface present on most host devices or laptops. The SCSI (small computer system interface) interface **1220** translates the data received via the SCSI connector **1240** into data understood by the DSP **1300**, as known by those skilled in the art. Further, the first connecting device **12** comprises an EPP (enhanced parallel port) with a data transfer rate of approx. 1 MBps which delivers a more moderate data transfer rate of 1 MBps by comparison to the data transfer rate of 10 MBps of the SCSI interface. The EPP **1260** is connected to a 25-pin D-shell connector **1280** to permit attachment to a printer interface of a host device for example. Optionally, the first connecting device **12** also comprises a 25-pin connector **1282** which permits the attachment of 8 digital outputs and 8 digital inputs **1284** at a host device.

Preferably, the second connecting device comprises 8 BNC inputs with the calibration relay **1505**, a block **1510** with 8 device amplifiers with an overvoltage protection of ± 75 V, this block being connected in turn to 8 sample/hold (S&H) circuits **1515**. The calibration relays are relays which permit controlled changeover between a test voltage and a calibration reference voltage. Each sample/hold circuit is connected to a corresponding input of an 8-channel multiplexer **1520** which feeds its output signals via a programmable amplifier **1525** into an analog/digital converter (ADC) with 12 bit and 1.25 MHz **1530** and to the DSP **1300**. The ADC **1530** is controlled by means of a 20-bit timer **1535**, as known by persons skilled in the art. The programmable amplifier **1525** and the 8-channel multiplexer **1520** are controlled via an amplifier channel selection circuit **1540** which is in turn controlled by the DSP **1300**.

The complete interface device **10** is supplied with power by an external AC/DC converter **1800** which delivers a digital supply voltage of ± 5 V and is attached to a DC/DC

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converter **1810** which can deliver analog supply voltages of ± 5 V and ± 15 V as required for the interface device **10**. Further, the DC/DC converter controls a precision voltage reference **1820** which controls the 8 BNC inputs **1505** and the ADC **1530** as well as a digital/analog converter (DAC) **1830** which permits, via an output amplifier block with 4 output amplifiers **1840** and a 9-pin connector **1850**, analog output direct from the DSP **1300** to an output device, e.g. printer device or monitor device, which can be attached via the 9-pin connector **1850**, thus providing the option of monitoring the data transferred to the host device or also, for example, of viewing an FFT to obtain rapid and comprehensive data analysis without using processor time of the host device.

In FIG. 2 the memory means **14** of FIG. 1 is implemented by an EPROM **1400** which, in a preferred embodiment of the present invention, contains the operating system of the digital signal processor **1300**. A random access memory with an access time of 15 ns and a size of 512 KB or optionally 1024 KB **1420** serves as a data buffer to achieve independence in terms of time of the output line **16** from the output lines **11a**, **11b** and **11c** to the data transmit/receive device and to the host device respectively. As described above, in a preferred embodiment of the present invention the digital signal processor **1300** already contains a 20-KB on-chip RAM **1440** which can store certain instruction sets, functions and also smaller application software units.

The connection, symbolized by the line **16**, of the interface device **10** to any data transmit/receive device implements, by means of the blocks 1505–1535, an analog input with a sampling rate of 1.25 MHz and quantization of 12 bits. There are 8 channels with an overvoltage protection of ± 75 V. By means of the programmable amplifier **1525** the channels can be programmed independently of each other in voltage ranges up to a maximum of ± 10 V. Unused channels can be grounded internally to reduce channel intermodulation. The block **1515** is implemented as a monolithic high-precision, high-speed sample/hold amplifier for simultaneous sampling of all channels. The precision voltage reference **1820** provides a high-precision, temperature-compensated monolithic energy gap voltage reference for auto-calibration of each channel and each gain. Further, offset fine adjustment for each channel is implemented by the same.

The blocks **1830**, **1840** and **1850** implement a direct analog output for the digital signal processor **1300**, and the DAC **1830** provides a data transfer rate of 625 kHz and a quantization of 12 bits. The block **1840** comprises 4 channels with a common output latch.

Further, the interface device **10** comprises a digital input/output device implemented by the blocks **1284** and **1282**. Here there are 8 digital inputs, 8 digital outputs with a common latch, and the digital port can be attached preferably to a side panel of the interface device **10** so that the port itself can easily be accessed.

The digital signal processor **1300** provides on-board digital data processing. In particular, it is a high-performance DSP with a clock speed of 80 MHz and a 20-bit timer **1535**.

As described above, the first connecting device **12** comprises the SCSI interface **1220** with a peak transfer rate of 10 MBps. An optional PCMCIA-to-SCSI adapter permits high-speed communication with laptop computers which are desirable and in widespread use, particularly by mobile service technicians. The EPP **1260** with its associated connector **1280** permits data transfer at a more moderate rate.

As described above, the interface device **10** is supplied with power by means of an external AC/DC adapter which

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has a universal power input (85–264 VAC, 47–63 Hz). Interference suppression complies with the standards EN 55022, curve B and FFC, Class B). Further, it is also in accordance with international safety regulations (TÜV, UL, CSA). The interface device 10 is externally shielded and achieves a value of 55 dB at 30–60 MHz and a value of approximately 40 dB at 1 GHz, and therefore complies with the MILSTD 285-1 standard.

As described above, communication between the host device and the multi-purpose interface can take place not only via drivers for input/output device customary in a host device which reside in the BIOS system of the host device but also via specific interface drivers which, in the case of SCSI interfaces, are known as multi-purpose interface ASPI (advanced SCSI programming interface) drivers. This ASPI driver, which can also be referred to as an ASPI manager, is specific to a special SCSI host adapter, i.e. to a special multi-purpose interface, and is normally included by the manufacturer of the multi-purpose interface. Generally speaking, this multi-purpose interface driver has the task of moving precisely specified SCSI commands from the host system program to the host system SCSI adapter. For this reason, the command set is almost identical to that of the SCSI interface itself. Essentially, only status and reset commands for the host adapter have been added.

The ASPI driver can be used if the hard disk was not already addressable at boot time or if the SCSI-related BIOS routines of the host computer were still disabled. Here too, the steps needed to initialize the interface device, preferably as a virtual hard disk, are similar to the steps taken when initializing at boot time.

In general terms, the ASPI manager comprises two sides. One side is the proprietary, hardware-oriented side. It is responsible for converting all commands into a form required by the corresponding multi-purpose interface. The hardware-oriented side of the ASPI driver is therefore matched to a very specific type of multi-purpose interface or SCSI interface. The other side is known as the user software side. This side is totally independent of the proprietary operating characteristics of the SCSI adapter and is therefore identical for all SCSI interfaces. This permits SCSI programming which is however independent of the individual SCSI adapter types.

In contrast to communication between the host device and the interface device according to the present invention on the basis of a BIOS driver, the use of such an ASPI driver for communication between the host device and the interface device according to the present invention allows various further possibilities of the SCSI multi-purpose interface to be exploited. In the case described above, the interface device which preferably signs on and behaves as a virtual hard disk is detected by the BIOS driver of the host computer at boot time and is configured as a hard disk. This step does not however support active requests sent by the interface device to the host computer. If however the virtual hard disk wishes to write data actively to, for example, a hard disk of the host computer or wishes to initiate communication with the processor of the host computer, the host computer must recognize the request of the virtual hard disk and tolerate a further issuer of instructions on its bus. If the interface device behaves solely like a virtual hard disk, it would always receive and never issue commands. The BIOS has no objections to an additional issuer of commands that actively wishes to place data on the bus of the host device but the BIOS does not support the host device in recognizing corresponding requests of the interface device or in granting the interface device permission to access the bus.

Using the ASPI manager the interface device according to the present invention can now obtain active access to an

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SCSI hard disk of the host device connected to the same SCSI bus which, in contrast to the interface device, cannot be a virtual but a real SCSI mass storage device or also a further interface device according to the present invention. Thereupon, the interface device according to the present invention can write the desired data to the SCSI hard disk of the host computer totally independently of the host computer or can communicate with the same in some other manner. The interface device according to the present invention therefore initially behaves passively as a virtual hard disk and then, as required and using the driver software for the multi-purpose interface, actively on the same SCSI bus. This means however that the interface device according to the present invention, using a driver software for the multi-purpose interface which comprises the BIOS routines customary in host devices and simultaneously provides the option of active participation, can, regardless of the type of the data transmit/receive device attached to the second connecting device, behave initially as a virtual and at the same time passive hard disk but can, as required, participate actively on the bus so as to be able to initiate communication directly with other SCSI hard disks of the host device by bypassing the processor of the host device.

Using a standard interface of a host device, the interface device according to the present invention permits communication with any host device. By simulating an input/output device to the host device and, in a preferred embodiment, by simulating a virtual mass storage device, the interface device 10 is automatically supported by all known host systems without any additional sophisticated driver software. The simulation of a freely definable file structure on the “virtual” hard disk provides simple operation and expansion options and, through the implementation of any programs, independence from special software implemented on the host device. Help files included on the interface device 10 and plug-and-play support ensure ease of use even in portable, flexible host devices. Despite the very simple user interface, experienced users are free at any time to intervene in the functions of the interface device 10 on system level. The interface device 10 thus provides a universal solution which can cover the entire spectrum of possible data transmit/receive devices.

What is claimed is:

1. An interface device for communication between a host device, which comprises drivers for input/output devices customary in a host device and a multi-purpose interface, and a data transmit/receive device, the data transmit/receive device being arranged for providing analog data, comprising:

a processor;

a memory;

a first connecting device for interfacing the host device with the interface device via the multi-purpose interface of the host device; and

a second connecting device for interfacing the interface device with the data transmit/receive device, the second connecting device including a sampling circuit for sampling the analog data provided by the data transmit/receive device and an analog-to-digital converter for converting data sampled by the sampling circuit into digital data,

wherein the interface device is configured by the processor and the memory to include a first command interpreter and a second command interpreter,

wherein the first command interpreter is configured in such a way that the command interpreter, when receiving an inquiry from the host device as to a type of a device attached to the multi-purpose interface of the

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host device, sends a signal, regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, to the host device which signals to the host device that it is an input/output device customary in a host device, whereupon the host device communicates with the interface device by means of the driver for the input/output device customary in a host device, and

wherein the second command interpreter is configured to interpret a data request command from the host device to the type of input/output device signaled by the first command interpreter as a data transfer command for initiating a transfer of the digital data to the host device.

2. An interface device according to claim 1, wherein the drivers for input/output drivers customary in a host device comprise a hard disk driver, and the signal indicates to the host device that the host device is communicating with a hard disk.

3. An interface device according to claim 1, wherein the memory means comprises a buffer to buffer data to be transferred between the data transmit/receive device and the host device.

4. An interface device according to claim 1, wherein the multi-purpose interface of the host device is an SCSI interface and the first connecting device also comprises an SCSI interface.

5. An interface device according to claim 1, wherein the processor is a digital signal processor.

6. An interface device according to claim 2, wherein the data to be transferred from the data transmit/receive device to the host device in the interface device is formatted in a suitable format for a hard disk present in the host device.

7. An interface device according to claim 2, which further comprises a root directory and virtual files which are present on the signaled hard disk drive and which can be accessed from the host device.

8. An interface device according to claim 7, wherein the virtual files comprise a configuration file in text format which are stored in the memory means and using which the user can configure the interface device for a specific data transmit/receive device.

9. An interface device according to claim 7, wherein the virtual files comprise batch files or executable files for the microprocessor means which are stored in the interface device in order to perform data processing, independently of the host device, of data received via the second connecting device.

10. An interface device according to claim 7, wherein the virtual files comprise batch files or executable files for the host device which are stored in the interface device.

11. An interface device for communication between a host device, which comprises a multi-purpose interface and a specific driver for this interface, and a data transmit/receive device, the data transmit/receive device being arranged for providing analog data, comprising:

- a processor;
- a memory;
- a first connecting device for interfacing the host device with the interface device via the multi-purpose interface of the host device; and
- a second connecting device for interfacing the interface device with the data transmit/receive device, the second connecting device including a sampling circuit for sampling the analog data provided by the data transmit/receive device and an analog-to-digital converter for converting data sampled by the sampling circuit into digital data,

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where the interface device is configured using the processor and the memory to include a first command interpreter and a second command interpreter,

wherein the first command interpreter is configured in such a way that the interface device, when receiving an inquiry from the host device as to the type of a device attached at the multi-purpose interface of the host device, sends a signal, regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, to the host device which signals to the host device that it is an input/output device customary in a host device, whereupon the host device communicates with the interface device by means of the specific driver for the multi-purpose interface, and

wherein the second command interpreter is configured to interpret a data request command from the host device to the type of input/output device signaled by the first command interpreter as a data transfer command for initiating a transfer of the digital data to the host device.

12. An interface device according to claim 11, wherein in addition to the first connecting device of the interface device, there is a further input/output device at the multi-purpose interface of the host device, and wherein the interface device can communicate directly with said further input/output device via the specific driver for the multi-purpose interface.

13. An interface device according to claim 11,

wherein the multi-purpose interface is an SCSI interface, and wherein the specific driver for the multi-purpose interface is an ASPI manager.

14. A method of communication between a host device, which comprises drivers for input/output devices customary in a host device and a multi-purpose interface, and a data transmit/receive device, the data transmit/receive device being arranged for providing analog data, via an interface device, comprising:

interfacing of the host device with a first connecting device of the interface device via the multi-purpose interface of the host device;

interfacing of the data transmit/receive device with a second connecting device of the interface device, the second connecting device including a sampling circuit for sampling the analog data provided by the data transmit/receive device and an analog-to-digital converter for converting data sampled by the sampling circuit into digital data;

inquiring by the host device at the interface device as to the type of device to which the multi-purpose interface of the host device is attached;

regardless of the type of the data transmit/receive data attached to the second connecting device of the interface device, responding to the inquiry from the host device by the interface device in such a way that it is an input/output device customary in a host device, whereupon the host device communicates with the interface device by means of the usual driver for the input/output device, and

interpreting a data request command from the host device to the type of input/output device customary in the host device as a data transfer command for initiating a transfer of the digital data to the host device.

15. A method according to claim 14,

wherein the drivers for input/output devices customary in a host device comprise a driver for a storage device and in particular for a hard disk drive.

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(12) **United States Patent**
Tasler

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(45) **Date of Patent:** May 17, 2005

(54) **FLEXIBLE INTERFACE FOR COMMUNICATION BETWEEN A HOST AND AN ANALOG I/O DEVICE CONNECTED TO THE INTERFACE REGARDLESS THE TYPE OF THE I/O DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 369 days.

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(30) Foreign Application Priority Data

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709/220

(58) Field of Search 710/8, 16, 64,
710/11, 12, 15, 62, 63; 703/23, 24, 25;
709/220, 222

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Primary Examiner—Jeffrey Gaffin

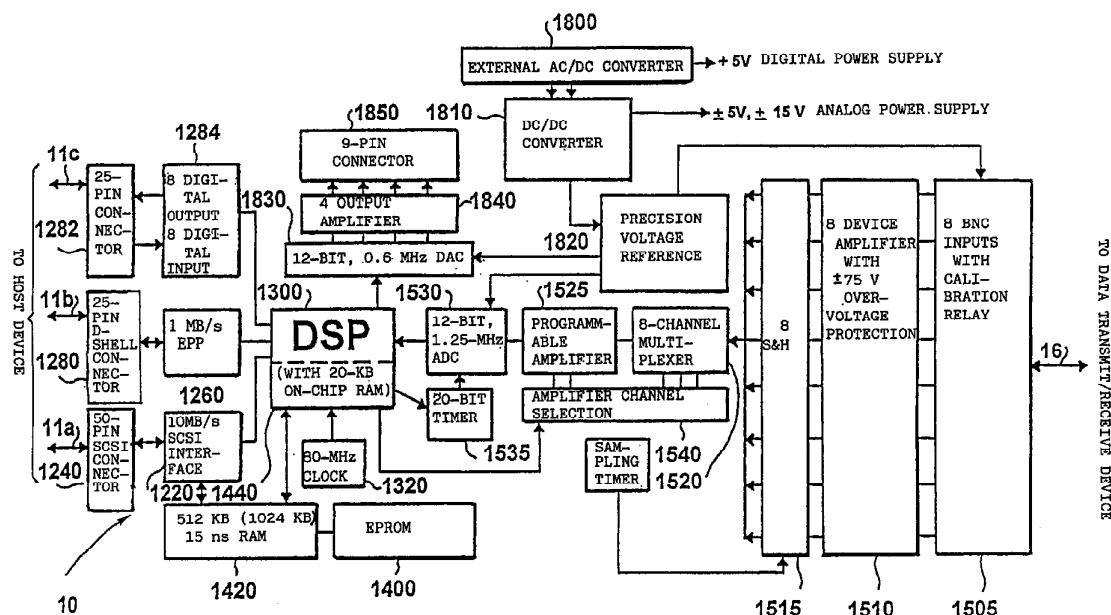
Assistant Examiner—Harold Kim

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(57) ABSTRACT

An interface device (10) provides fast data communication between a host device with input/output interfaces and a data transmit/receive device, wherein the interface device (10) comprises a processor means (13), a memory means (14), a first connecting device (12) for interfacing the host device with the interface device, and a second connecting device (15) for interfacing the interface device (10) with the data transmit/receive device. The interface device (10) is configured by the processor means (13) and the memory means (14) in such a way that, when receiving an inquiry from the host device via the first connecting device (12) as to the type of a device attached to the host device, regardless of the type of the data transmit/receive device, the interface device sends a signal to the host device via the first connecting device (12) which signals to the host device that it is communicating with an input/output device.

18 Claims, 2 Drawing Sheets



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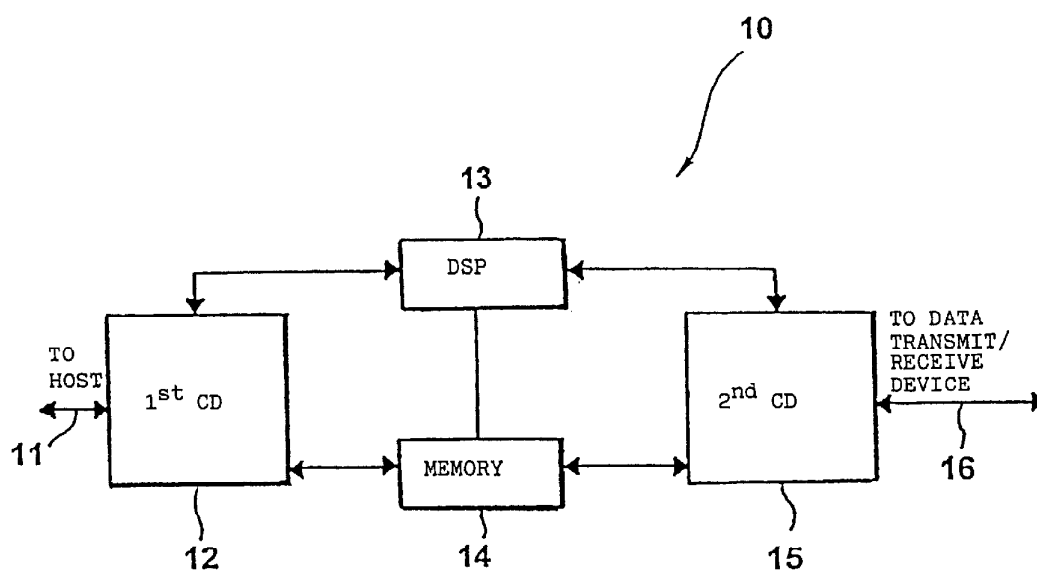


FIG. 1

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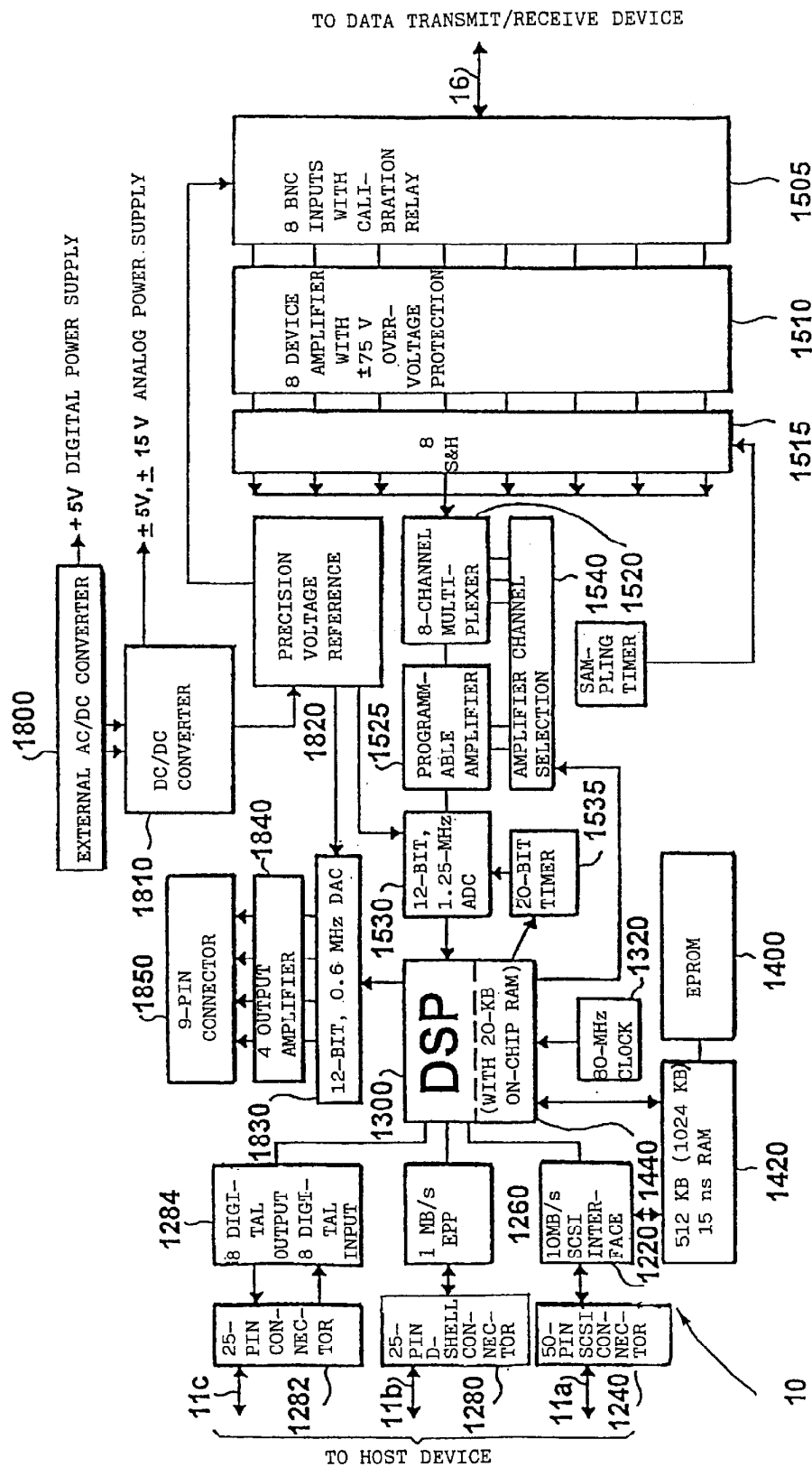


FIG. 2

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**FLEXIBLE INTERFACE FOR
COMMUNICATION BETWEEN A HOST AND
AN ANALOG I/O DEVICE CONNECTED TO
THE INTERFACE REGARDLESS THE TYPE
OF THE I/O DEVICE**

RELATED APPLICATIONS

This application is a divisional application of copending application Ser. No. 09/331,002 filed Jun. 14, 1999.

DESCRIPTION

The present invention relates to the transfer of data and in particular to interface devices for communication between a computer or host device and a data transmit/receive device from which data is to be acquired or with which two-way communication is to take place.

Existing data acquisition systems for computers are very limited in their areas of application. Generally such systems can be classified into two groups.

In the first group host devices or computer systems are attached by means of an interface to a device whose data is to be acquired. The interfaces of this group are normally standard interfaces which, with specific driver software, can be used with a variety of host systems. An advantage of such interfaces is that they are largely independent of the host device. However, a disadvantage is that they generally require very sophisticated drivers which are prone to malfunction and which limit data transfer rates between the device connected to the interface and the host device and vice versa. Further, it is often very difficult to implement such interfaces for portable systems and they offer few possibilities for adaptation with the result that such systems offer little flexibility.

The devices from which data is to be acquired cover the entire electrical engineering spectrum. In a typical case, it is assumed that a customer who operates, for example, a diagnostic radiology system in a medical engineering environment reports a fault. A field service technician of the system manufacturer visits the customer and reads system log files generated by the diagnostic radiology system by means of a portable computer or laptop for example. If the fault cannot be localized or if the fault is intermittent, it will be necessary for the service technician to read not only an error log file but also data from current operation. It is apparent that in this case fast data transfer and rapid data analysis are necessary.

Another case requiring the use of an interface could be, for example, when an electronic measuring device, e.g. a multimeter, is attached to a computer system to transfer the data measured by the multimeter to the computer. Particularly when long-term measurements or large volumes of data are involved it is necessary for the interface to support a high data transfer rate.

From these randomly chosen examples it can be seen that an interface may be put to totally different uses. It is therefore desirable that an interface be sufficiently flexible to permit attachment of very different electrical or electronic systems to a host device by means of the interface. To prevent operator error, it is also desirable that a service technician is not required to operate different interfaces in different ways for different applications but that, if possible, a universal method of operating the interface be provided for a large number of applications.

To increase the data transfer rates across an interface, the route chosen in the second group of data acquisition systems

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for the interface devices was to specifically match the interface very closely to individual host systems or computer systems. The advantage of this solution is that high data transfer rates are possible. However, a disadvantage is that the drivers for the interfaces of the second group are very closely matched to a single host system with the result that they generally cannot be used with other host systems or their use is very ineffective. Further, such types of interface have the disadvantage that they must be installed inside the computer casing to achieve maximum data transfer rates as they access the internal host bus system. They are therefore generally not suitable for portable host systems in the form of laptops whose minimum possible size leaves little internal space to plug in an interface card.

A solution to this problem is offered by the interface devices of Iotech (business address: 25971 Cannon Road, Cleveland, Ohio 44146, USA) which are suitable for laptops such as the WaveBook/512 (registered trademark). The interface devices are connected by means of a plug-in card, approximately the size of a credit card, to the PCMCIA interface which is now a standard feature in laptops. The plug-in card converts the PCMCIA interface into an interface known in the art as IEEE 1284. The said plug-in card provides a special printer interface which is enhanced as regards the data transfer rate and delivers a data transfer rate of approximately 2 MBps as compared with a rate of approx. 1 MBps for known printer interfaces. The known interface device generally consists of a driver component, a digital signal processor, a buffer and a hardware module which terminates in a connector to which the device whose data is to be acquired is attached. The driver component is attached directly to the enhanced printer interface thus permitting the known interface device to establish a connection between a computer and the device whose data is to be acquired.

In order to work with the said interface, an interface-specific driver must be installed on the host device so that the host device can communicate with the digital signal processor of the interface card. As described above, the driver must be installed on the host device. If the driver is a driver developed specifically for the host device, a high data transfer rate is achieved but the driver cannot be easily installed on a different host system. However, if the driver is a general driver which is as flexible as possible and which can be used on many host devices, compromises must be accepted with regard to the data transfer rate.

Particularly in an application for multi-tasking systems in which several different tasks such as data acquisition, data display and editing are to be performed quasi-simultaneously, each task is normally assigned a certain priority by the host system. A driver supporting a special task requests the central processing system of the host device for processor resources in order to perform its task. Depending on the particular priority assignment method and on the driver implementation, a particular share of processor resources is assigned to a special task in particular time slots. Conflicts arise if one or more drivers are implemented in such a way that they have the highest priority by default, i.e. they are incompatible, as happens in practice in many applications. It may occur that both drivers are set to highest priority which, in the worst case, can result in a system crash.

EP 0685799 A1 discloses an interface by means of which several peripheral devices can be attached to a bus. An interface is connected between the bus of a host device and various peripheral devices. The interface comprises a finite state machine and several branches each of which is assigned to a peripheral device. Each branch comprises a

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data manager, cycle control, user logic and a buffer. This known interface device provides optimal matching between a host device and a specific peripheral device.

The specialist publication IBM Technical Disclosure Bulletin, Vol. 38, No. 05, page 245; "Communication Method between Devices through FDD Interface" discloses an interface which connects a host device to a peripheral device via a floppy disk drive interface. The interface consists in particular of an address generator, an MFM encoder/decoder, a serial/parallel adapter and a format signal generator. The interface makes it possible to attach not only a floppy disk drive but also a further peripheral device to the FDD host controller of a host device. The host device assumes that a floppy disk drive is always attached to its floppy disk drive controller and communication is initiated if the address is correct. However, this document contains no information as to how communication should be possible if the interface is connected to a multi-purpose interface instead of to a floppy disk drive controller.

It is the object of the present invention to provide an interface device for communication between a host device and a data transmit/receive device whose use is host device-independent and which delivers a high data transfer rate.

This object is achieved by an interface device according to claim 1 or 12 and by a method according to claim 15.

The present invention is based on the finding that both a high data transfer rate and host device-independent use can be achieved if a driver for an input/output device customary in a host device, normally present in most commercially available host devices, is utilized. Drivers for input/output devices customary in a host device which are found in practically all host devices are, for example, drivers for hard disks, for graphics devices or for printer devices. As however the hard disk interfaces in common host devices which can be, for example, IBM PCs, IBM-compatible PCs, Commodore PCs, Apple computers or even workstations, are the interfaces with the highest data transfer rate, the hard disk driver is utilized in the preferred embodiment of the interface device of the present invention. Drivers for other storage devices such as floppy disk drives, CD-ROM drives or tape drives could also be utilized in order to implement the interface device according to the present invention.

As described in the following, the interface device according to the present invention is to be attached to a host device by means of a multi-purpose interface of the host device which can be implemented, for example, as an SCSI interface or as an enhanced printer interface. Multi-purpose interfaces comprise both an interface card and specific driver software for the interface card. The driver software can be designed so that it can replace the BIOS driver routines. Communication between the host device and the devices attached to the multi-purpose interface then essentially takes place by means of the specific driver software for the multi-purpose interface and no longer primarily by means of BIOS routines of the host device. Recently however drivers for multi-purpose interfaces can also already be integrated in the BIOS system of the host device as, alongside classical input/output interfaces, multi-purpose interfaces are becoming increasingly common in host devices. It is of course also possible to use BIOS routines in parallel with the specific driver software for the multi-purpose interface, if this is desired.

The interface device according to the present invention comprises a processor means, a memory means, a first connecting device for interfacing the host device with the interface device, and a second connecting device for inter-

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facing the interface device with the data transmit/receive device. The interface device is configured by the processor means and the memory means in such a way that the interface device, when receiving an inquiry from the host device via the first connecting device as to the type of a device attached to the host device, sends a signal, regardless of the type of the data transmit/receive device, to the host device via the first connecting device which signals to the host device that it is communicating with an input/output device. The interface device according to the present invention therefore simulates, both in terms of hardware and software, the way in which a conventional input/output device functions, preferably that of a hard disk drive. As support for hard disks is implemented as standard in all commercially available host systems, the simulation of a hard disk, for example, can provide host device-independent use. The interface device according to the present invention therefore no longer communicates with the host device or computer by means of a specially designed driver but by means of a program which is present in the BIOS system (Basic Input/Output System) and is normally precisely matched to the specific computer system on which it is installed, or by means of a specific program for the multi-purpose interface. Consequently, the interface device according to the present invention combines the advantages of both groups. On the one hand, communication between the computer and the interface takes place by means of a host device-specific BIOS program or by means of a driver program which is matched to the multi-purpose interface and which could be regarded as a "device-specific driver". On the other hand, the BIOS program or a corresponding multi-purpose interface program which operates one of the common input/output interfaces in host systems is therefore present in all host systems so that the interface device according to the present invention is host device-independent.

In the following, preferred embodiments of the present invention will be explained in more detail with reference to the drawings enclosed, in which:

FIG. 1 shows a general block diagram of the interface device according to the present invention; and

FIG. 2 shows a detailed block diagram of an interface device according to a preferred embodiment of the present invention.

FIG. 1 shows a general block diagram of an interface device 10 according to the present invention. A first connecting device 12 of the interface device 10 can be attached to a host device (not shown) via a host line 11. The first connecting device is attached both to a digital signal processor 13 and to a memory means 14. The digital signal processor 13 and the memory means 14 are also attached to a second connecting device 15 by means of bi-directional communication lines (shown for all lines by means of two directional arrows). The second connecting device can be attached by means of an output line 16 to a data transmit/receive device which is to receive data from the host device or from which data is to be read, i.e. acquired, and transferred to the host device. The data transmit/receive device itself can also communicate actively with the host device via the first and second connecting device, as described in more detail in the following.

Communication between the host system or host device and the interface device is based on known standard access commands as supported by all known operating systems (e.g. DOS, Windows, Unix). Preferably, the interface device according to the present invention simulates a hard disk with

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a root directory whose entries are "virtual" files which can be created for the most varied functions. When the host device system with which the interface device according to the present invention is connected is booted and a data transmit/receive device is also attached to the interface device **10**, usual BIOS routines or multi-purpose interface programs issue an instruction, known by those skilled in the art as the INQUIRY instruction, to the input/output interfaces in the host device. The digital signal processor **13** receives this inquiry instruction via the first connecting device and generates a signal which is sent to the host device (not shown) again via the first connecting device **12** and the host line **11**. This signal indicates to the host device that, for example, a hard disk drive is attached at the interface to which the INQUIRY instruction was sent. Optionally, the host device can send an instruction, known by those skilled in the art as "Test Unit Ready", to the interface device to request more precise details regarding the queried device.

Regardless of which data transmit/receive device at the output line **16** is attached to the second connecting device, the digital signal processor **13** informs the host device that it is communicating with a hard disk drive. If the host device receives the response that a drive is present, it then sends a request to the interface device **10** to read the boot sequence which, on actual hard disks, normally resides on the first sectors of the disk. The digital signal processor **13**, whose operating system is stored in the memory means **14**, responds to this instruction by sending to the host device a virtual boot sequence which, in the case of actual drives, includes the drive type, the starting position and the length of the file allocation table (FAT), the number of sectors, etc., known to those skilled in the art. Once the host device has received this data, it assumes that the interface device **10** according to a preferred embodiment of the present invention is a hard disk drive. In reply to an instruction from the host device to display the directory of the "virtual" hard disk drive simulated by the interface device **10** with respect to the host device, the digital signal processor can respond to the host device in exactly the same way as a conventional hard disk would, namely by reading on request the file allocation table or FAT on a sector specified in the boot sequence, normally the first writable sector, and transferring it to the host device, and subsequently by transferring the directory structure of the virtual hard disk. Further, it is possible that the FAT is not read until immediately prior to reading or storing the data of the "virtual" hard disk and not already at initialization.

In a preferred embodiment of the present invention, the digital signal processor **13**, which need not necessarily be implemented as a digital signal processor but may be any other kind of microprocessor, comprises a first and a second command interpreter. The first command interpreter carries out the steps described above whilst the second command interpreter carries out the read/write assignment to specific functions. If the user now wishes to read data from the data transmit/receive device via the line **16**, the host device sends a command, for example "read file xy", to the interface device. As described above, the interface device appears to the host device as a hard disk. The second command interpreter of the digital signal processor now interprets the read command of the host processor as a data transfer command, by decoding whether "xy" denotes, for example, a "real-time input" file, a "configuration" file or an executable file, whereby the same begins to transfer data from the data transmit/receive device via the second connecting device to the first connecting device and via the line **11** to the host device.

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Preferably, the volume of data to be acquired by a data transmit/receive device is specified in a configuration file described in the following by the user specifying in the said configuration file that a measurement is to last, for example, five minutes. To the host device the "real-time input" file then appears as a file whose length corresponds to the anticipated volume of data in those five minutes. Those skilled in the art know that communication between a processor and a hard disk consists of the processor transferring to the hard disk the numbers of the blocks or clusters or sectors whose contents it wishes to read. By reference to the FAT the processor knows which information is contained in which block. In this case, communication between the host device and the interface device according to the present invention therefore consists of the very fast transfer of block numbers and preferably of block number ranges because a virtual "real-time input" file will not be fragmented. If the host device now wants to read the "real-time input" file, it transfers a range of block numbers to the interface device, whereupon data commences to be received via the second connecting device and data commences to be sent to the host device via the first connecting device.

In addition to the digital signal processor instruction memory, which comprises the operating system of the digital signal processor and can be implemented as an EPROM or EEPROM, the memory means **14** can have an additional buffer for purposes of synchronizing data transfer from the data transmit/receive device to the interface device **10** and data transfer from the interface device **10** to the host device.

Preferably, the buffer is implemented as a fast random access memory or RAM buffer.

Further, from the host device the user can also create a configuration file, whose entries automatically set and control various functions of the interface device **10**, on the interface device **10** which appears to the host device as a hard disk. These settings can be, for example, gain, multiplex or sampling rate settings. By creating and editing a configuration file, normally a text file which is simple to understand with little prior knowledge, users of the interface device **10** are able to perform essentially identical operator actions for almost any data transmit/receive devices which can be attached to the second connecting device via the line **16**, thus eliminating a source of error arising from users having to know many different command codes for different applications. In the case of the interface device **10** according to the present invention it is necessary for users to note the conventions of the configuration file once only in order to be able to use the interface device **10** as an interface between a host device and almost any data transmit/receive device.

As a result of the option of storing any files in agreed formats in the memory means **14** of the interface device **10**, taking into account the maximum capacity of the memory means, any enhancements or even completely new functions of the interface device **10** can be quickly implemented. Even files executable by the host device, such as batch files or executable files (BAT or EXE files), and also help files can be implemented in the interface device, thus achieving independence of the interface device **10** from any additional software (with the exception of the BIOS routines) of the host device. On the one hand, this avoids licensing and/or registration problems and, on the other hand, installation of certain routines which can be frequently used, for example an FFT routine to examine acquired time-domain data in the frequency domain, is rendered unnecessary as the EXE files are already installed on the interface device **10** and appear in the virtual root directory, by means of which the host device can access all programs stored on the interface device **10**.

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In a preferred embodiment of the present invention in which the interface device **10** simulates a hard disk to the host device, the interface device is automatically detected and readied for operation when the host system is powered up or booted. This corresponds to the plug-and-play standard which is currently finding increasingly widespread use. The user is no longer responsible for installing the interface device **10** on the host device by means of specific drivers which must also be loaded; instead the interface device **10** is automatically readied for operation when the host system is booted.

For persons skilled in the art it is however obvious that the interface device **10** is not necessarily signed on when the computer system is powered up but that a special BIOS routine or a driver for a multi-purpose interface can also be started on the host device during current operation of the computer system in order to sign on or mount the interface device **10** as an additional hard disk. This embodiment is suitable for larger workstation systems which are essentially never powered down as they perform, e.g. mail functions or monitor processes which run continuously, for example, in multi-tasking environments.

In the interface device according to the present invention an enormous advantage is to be gained, as apparent in the embodiment described in the following, in separating the actual hardware required to attach the interface device **10** to the data transmit/receive device from the communication unit, which is implemented by the digital signal processor **13**, the memory means **14** and the first connecting device **12**, as this allows a plurality of dissimilar device types to be operated in parallel in identical manner. Accordingly, many interface devices **10** can be connected to a host device which then sees many different "virtual" hard disks. In addition, any modification of the specific hardware symbolized by the second connecting device **15** can be implemented essentially without changing the operation of the interface device according to the present invention. Further, an experienced user can intervene at any time on any level of the existing second connecting device by making use of the above mentioned option of creating a configuration file or adding or storing new program sections for the second connecting device.

An important advantage of the interface device **10** of the present invention is that it also permits extremely high data transfer rates by using, for data interchange, the host device's own BIOS routines which are optimized for each host device by the host device manufacturer or BIOS system manufacturer, or by using driver programs which are normally optimized and included by the manufacturers of multi-purpose interfaces. Furthermore, due to the simulation of a virtual mass storage device, the data is managed and made available in such a way that it can be transferred directly to other storage media, e.g. to an actual hard disk of the host device without, as it were, intervention of the host device processor. The only limitation to long-term data transfer at high speed is therefore imposed exclusively by the speed and the size of the mass storage device of the host device. This is the case as the digital signal processor **13** already formats the data read by the data transmit/receive device via the second connecting device **15** into block sizes suitable for a hard disk of the host device, whereby the data transfer speed is limited only by the mechanical latency of the hard disk system of the host device. At this point, it should be noted that normally data flow from a host device must be formatted in blocks to permit writing to a hard disk and subsequent reading from a hard disk, as known by those skilled in the art.

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The said data transfer rate can be increased further by setting up a direct memory access (DMA) or RAM drive in the host system. As those skilled in the art know, the setting up of a RAM drive requires processor resources of the host device, with the result that the advantage of writing the data to a hard disk drive of the host device essentially without the need for processor resources is lost.

As described above, a data buffer can be implemented in the memory means **14** to permit independence in terms of time of the data transmit/receive device attached to the second connecting device from the host device attached to the first connecting device. This guarantees error-free operation of the interface device **10** even for time-critical applications in multi-tasking host systems.

FIG. 2 shows a detailed block diagram of an interface device **10** according to the present invention.

A digital signal processor (DSP) **1300** is, in a manner of speaking, the heart of the interface device **10**. The DSP can be any DSP but preferably has a 20-MB on-chip random access memory (RAM). Certain instruction sets, for example, can be stored in the RAM already integrated in the DSP. An 80-MHz clock generator is attached to the DSP **1300** in order to synchronize the DSP. The DSP implements a fast Fourier transformation (FFT) in real time and also optional data compression of the data to be transferred from the data transmit/receive device to the host device in order to achieve greater efficiency and to permit interoperability with host devices which have a smaller memory.

In the preferred embodiment of the interface device **10** shown in FIG. 2, the first connecting device **12** of FIG. 1 contains the following components: an SCSI interface **1220** and a 50-pin SCSI connector **1240** for attachment to an SCSI interface present on most host devices or laptops. The SCSI (small computer system interface) interface **1220** translates the data received via the SCSI connector **1240** into data understood by the DSP **1300**, as known by those skilled in the art. Further, the first connecting device **12** comprises an EPP (enhanced parallel port) with a data transfer rate of approx. 1 MBps which delivers a more moderate data transfer rate of 1 MBps by comparison to the data transfer rate of 10 MBps of the SCSI interface. The EPP **1260** is connected to a 25-pin D-shell connector **1280** to permit attachment to a printer interface of a host device for example. Optionally, the first connecting device **12** also comprises a 25-pin connector **1282** which permits the attachment of 8 digital outputs and 8 digital inputs **1284** at a host device.

Preferably, the second connecting device comprises 8 BNC inputs with the calibration relay **1505**, a block **1510** with 8 device amplifiers with an overvoltage protection of ± 75 V, this block being connected in turn to 8 sample/hold (S&H) circuits **1515**. The calibration relays are relays which permit controlled changeover between a test voltage and a calibration reference voltage. Each sample/hold circuit is connected to a corresponding input of an 8-channel multiplexer **1520** which feeds its output signals via a programmable amplifier **1525** into an analog/digital converter (ADC) with 12 bit and 1.25 MHz **1530** and to the DSP **1300**. The ADC **1530** is controlled by means of a 20-bit timer **1535**, as known by persons skilled in the art. The programmable amplifier **1525** and the 8-channel multiplexer **1520** are controlled via an amplifier channel selection circuit **1540** which is in turn controlled by the DSP **1300**.

The complete interface device **10** is supplied with power by an external AC/DC converter **1800** which delivers a digital supply voltage of ± 5 V and is attached to a DC/DC

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converter **1810** which can deliver analog supply voltages of ± 5 V and ± 15 V as required for the interface device **10**. Further, the DC/DC converter controls a precision voltage reference **1820** which controls the 8 BNC inputs **1505** and the ADC **1530** as well as a digital/analog converter (DAC) **1830** which permits, via an output amplifier block with 4 output amplifiers **1840** and a 9-pin connector **1850**, analog output direct from the DSP **1300** to an output device, e.g. printer device or monitor device, which can be attached via the 9-pin connector **1850**, thus providing the option of monitoring the data transferred to the host device or also, for example, of viewing an FFT to obtain rapid and comprehensive data analysis without using processor time of the host device.

In FIG. 2 the memory means **14** of FIG. 1 is implemented by an EPROM **1400** which, in a preferred embodiment of the present invention, contains the operating system of the digital signal processor **1300**. A random access memory with an access time of 15 ns and a size of 512 KB or optionally 1024 KB **1420** serves as a data buffer to achieve independence in terms of time of the output line **16** from the output lines **11a**, **11b** and **11c** to the data transmit/receive device and to the host device respectively. As described above, in a preferred embodiment of the present invention the digital signal processor **1300** already contains a 20-KB on-chip RAM **1440** which can store certain instruction sets, functions and also smaller application software units.

The connection, symbolized by the line **16**, of the interface device **10** to any data transmit/receive device implements, by means of the blocks **1505–1535**, an analog input with a sampling rate of 1.25 MHz and quantization of 12 bits. There are 8 channels with an overvoltage protection of ± 75 V. By means of the programmable amplifier **1525** the channels can be programmed independently of each other in voltage ranges up to a maximum of ± 10 V. Unused channels can be grounded internally to reduce channel intermodulation. The block **1515** is implemented as a monolithic high-precision, high-speed sample/hold amplifier for simultaneous sampling of all channels. The precision voltage reference **1820** provides a high-precision, temperature-compensated monolithic energy gap voltage reference for auto-calibration of each channel and each gain. Further, offset fine adjustment for each channel is implemented by the same.

The blocks **1830**, **1840** and **1850** implement a direct analog output for the digital signal processor **1300**, and the DAC **1830** provides a data transfer rate of 625 kHz and a quantization of 12 bits. The block **1840** comprises 4 channels with a common output latch.

Further, the interface device **10** comprises a digital input/output device implemented by the blocks **1284** and **1282**. Here there are 8 digital inputs, 8 digital outputs with a common latch, and the digital port can be attached preferably to a side panel of the interface device **10** so that the port itself can easily be accessed.

The digital signal processor **1300** provides on-board digital data processing. In particular, it is a high-performance DSP with a clock speed of 80 MHz and a 20-bit timer **1535**.

As described above, the first connecting device **12** comprises the SCSI interface **1220** with a peak transfer rate of 10 MBps. An optional PCMCIA-to-SCSI adapter permits high-speed communication with laptop computers which are desirable and in widespread use, particularly by mobile service technicians. The EPP **1260** with its associated connector **1280** permits data transfer at a more moderate rate.

As described above, the interface device **10** is supplied with power by means of an external AC/DC adapter which

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has a universal power input (85–264 VAC, 47–63 Hz). Interference suppression complies with the standards EN 55022, curve B and FFC, Class B). Further, it is also in accordance with international safety regulations (TÜV, UL, CSA). The interface device **10** is externally shielded and achieves a value of 55 dB at 30–60 MHz and a value of approximately 40 dB at 1 GHz, and therefore complies with the MILSTD 285-1 standard.

As described above, communication between the host device and the multi-purpose interface can take place not only via drivers for input/output device customary in a host device which reside in the BIOS system of the host device but also via specific interface drivers which, in the case of SCSI interfaces, are known as multi-purpose interface ASPI (advanced SCSI programming interface) drivers. This ASPI driver, which can also be referred to as an ASPI manager, is specific to a special SCSI host adapter, i.e. to a special multi-purpose interface, and is normally included by the manufacturer of the multi-purpose interface. Generally speaking, this multi-purpose interface driver has the task of moving precisely specified SCSI commands from the host system program to the host system SCSI adapter. For this reason, the command set is almost identical to that of the SCSI interface itself. Essentially, only status and reset commands for the host adapter have been added.

The ASPI driver can be used if the hard disk was not already addressable at boot time or if the SCSI-related BIOS routines of the host computer were still disabled. Here too, the steps needed to initialize the interface device, preferably as a virtual hard disk, are similar to the steps taken when initializing at boot time.

In general terms, the ASPI manager comprises two sides. One side is the proprietary, hardware-oriented side. It is responsible for converting all commands into a form required by the corresponding multi-purpose interface. The hardware-oriented side of the ASPI driver is therefore matched to a very specific type of multi-purpose interface or SCSI interface. The other side is known as the user software side. This side is totally independent of the proprietary operating characteristics of the SCSI adapter and is therefore identical for all SCSI interfaces. This permits SCSI programming which is however independent of the individual SCSI adapter types.

In contrast to communication between the host device and the interface device according to the present invention on the basis of a BIOS driver, the use of such an ASPI driver for communication between the host device and the interface device according to the present invention allows various further possibilities of the SCSI multi-purpose interface to be exploited. In the case described above, the interface device which preferably signs on and behaves as a virtual hard disk is detected by the BIOS driver of the host computer at boot time and is configured as a hard disk. This step does not however support active requests sent by the interface device to the host computer. If however the virtual hard disk wishes to write data actively to, for example, a hard disk of the host computer or wishes to initiate communication with the processor of the host computer, the host computer must recognize the request of the virtual hard disk and tolerate a further issuer of instructions on its bus. If the interface device behaves solely like a virtual hard disk, it would always receive and never issue commands. The BIOS has no objections to an additional issuer of commands that actively wishes to place data on the bus of the host device but the BIOS does not support the host device in recognizing corresponding requests of the interface device or in granting the interface device permission to access the bus.

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Using the ASPI manager the interface device according to the present invention can now obtain active access to an SCSI hard disk of the host device connected to the same SCSI bus which, in contrast to the interface device, cannot be a virtual but a real SCSI mass storage device or also a further interface device according to the present invention. Thereupon, the interface device according to the present invention can write the desired data to the SCSI hard disk of the host computer totally independently of the host computer or can communicate with the same in some other manner. The interface device according to the present invention therefore initially behaves passively as a virtual hard disk and then, as required and using the driver software for the multi-purpose interface, actively on the same SCSI bus. This means however that the interface device according to the present invention, using a driver software for the multi-purpose interface which comprises the BIOS routines customary in host devices and simultaneously provides the option of active participation, can, regardless of the type of the data transmit/receive device attached to the second connecting device, behave initially as a virtual and at the same time passive hard disk but can, as required, participate actively on the bus so as to be able to initiate communication directly with other SCSI hard disks of the host device by bypassing the processor of the host device.

Using a standard interface of a host device, the interface device according to the present invention permits communication with any host device. By simulating an input/output device to the host device and, in a preferred embodiment, by simulating a virtual mass storage device, the interface device 10 is automatically supported by all known host systems without any additional sophisticated driver software. The simulation of a freely definable file structure on the "virtual" hard disk provides simple operation and expansion options and, through the implementation of any programs, independence from special software implemented on the host device. Help files included on the interface device 10 and plug-and-play support ensure ease of use even in portable, flexible host devices. Despite the very simple user interface, experienced users are free at any time to intervene in the functions of the interface device 10 on system level. The interface device 10 thus provides a universal solution which can cover the entire spectrum of possible data transmit/receive devices.

What is claimed is:

1. An interface device for communication between a host device, which comprises drivers for input/output devices customary in a host device and a multi-purpose interface, and a data transmit/receive device comprising the following features:

- a processor;
- a memory;
- a first connecting device for interfacing the host device with the interface device via the multi-purpose interface of the host device; and
- a second connecting device for interfacing the interface device with the data transmit/receive device,

wherein the interface device is configured by the processor and the memory in such a way that the interface device, when receiving an inquiry from the host device as to the type of a device attached to the multi-purpose interface of the host device, sends a signal, regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, to the host device which signals to the host device that it is a storage device customary in a host device,

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whereupon the host device communicates with the interface device by means of the driver for the storage device customary in a host device, and

wherein the interface device is arranged for simulating a virtual file system to the host, the virtual file system including a directory structure.

2. An interface device in accordance with claim 1, in which the directory structure has a configuration file for setting and controlling functions of the interface device or an executable or a batch file for conducting a routine stored in the memory or a data file used for transferring data from the data transmit/receive device to the host device or a help file for giving help on handling the interface device.

3. An interface device in accordance with claim 2 wherein the configuration file is a text file.

4. An interface device in accordance with claim 2 wherein the executable file includes a Fast Fourier Transform routine for transforming data acquired by the second connecting device into the frequency domain and for examining frequency domain data.

5. An interface device in accordance with claim 2 wherein the executable file includes a data compression routine for compressing data to be transmitted from the data transmit/receive device to the host device.

6. An interface device in accordance with claim 1 wherein, in response to a request from the host to read a boot sequence, the processor is arranged to send a virtual boot sequence to the host.

7. An interface device in accordance with claim 6 wherein the virtual boot sequence includes a starting position and a length of a file allocation table, an indication of a type of the storage device or a number of sectors of the storage device.

8. An interface device in accordance with claim 7 wherein, in response to a request from the host to display a directory of the storage device, a processor is arranged for transferring the file allocation table and the directory structure to the host.

9. An interface device in accordance with claim 1 wherein the file allocation table and the directory structure is transferred to the host in response to a request from the host to read data from or store data to the storage device.

10. An interface device in accordance with claim 1 wherein the directory structure includes a data file for transferring data from the data transmit/receive device to the host device wherein the processor is arranged to interpret a request from the host to read the data file as a request for a data transfer from the data transmit/receive device to the host, so that data is transmitted from the second connecting device to the first connecting device and to the host.

11. An interface device in accordance with claim 10 wherein the directory structure further includes a configuration file for specifying a time period for a measurement by the data transmit/receive device, wherein the interface device is arranged for simulating a length of the data file to the host that corresponds to an anticipated volume of data produced by the data transmit/receive device in the specified time period.

12. An interface device in accordance with claim 1 wherein the file allocation table includes information on numbers of blocks occupied by the data file wherein the interface device is arranged for receiving block numbers or a block number range from the host when the host wants to read the data file, and wherein the interface device is arranged to start a data transfer to the host, when the block numbers or the block number range is received from the host.

13. An interface device in accordance with claim 12 wherein the processor is arranged for formatting the data

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acquired by the second connecting device into blocks having a predetermined size, the predetermined size being suited for the storage device.

14. An interface device in accordance with claim 1 wherein the functions are gain, multiplex or synchronization settings of the second connecting device. 5

15. An interface device in accordance with claim 1 wherein the storage device is a hard disk.

16. An interface device in accordance with claim 1 wherein the memory has a data buffer for permitting independence in terms of time of the data transmit/receive device attachable to the second connecting device from the host device attachable to the first connecting device. 10

17. An interface device for communication between a host device, which comprises a multi-purpose interface and a specific driver for this interface, and a data transmit/receive device comprising the following features: 15

a processor;

a memory; 20

a first connecting device for interfacing the host device with the interface device via the multi-purpose interface of the host device; and

a second connecting device for interfacing the interface device with the data transmit/receive device, 25

where the interface device is configured using the processor and the memory in such a way that the interface device, when receiving an inquiry from the host device as to the type of a device attached at the multi-purpose interface of the host device, sends a signal, regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, to the host device which signals to the host device that it is a storage device customary in a host device, 30

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whereupon the host device communicates with the interface device by means of the specific driver for the multi-purpose interface, and

wherein the interface device is arranged for simulating a virtual file system to the host, the virtual file system including a file allocation table and a directory structure.

18. A method of communication between a host device, which comprises drivers for input/output devices customary in a host device and a multi-purpose interface, and a data transmit/receive device via an interface device comprising the following steps:

interfacing of the host device with a first connecting device of the interface device via the multi-purpose interface of the host device;

interfacing of the data transmit/receive device with a second connecting device of the interface device;

inquiring by the host device at the interface device as to the type of device to which the multi-purpose interface of the host device is attached;

regardless of the type of the data transmit/receive device attached to the second connecting device of the interface device, responding to the inquiry from the host device by the interface device in such a way that it is a storage device customary in a host device, whereupon the host device communicates with the interface device by means of the usual driver for the storage device, and wherein the interface device is arranged for simulating a virtual file system to the host, the virtual file system including a file allocation table and a directory structure.

* * * * *

**CONTAINS CONFIDENTIAL BUSINESS INFORMATION
SUBJECT TO PROTECTIVE ORDER**

**IN THE UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF COLUMBIA**

IN RE PAPST LICENSING GMBH & CO
KG LITIGATION

This Document Relates To:

All Cases

Misc. Action No. 07-439 (RMC)
MDL Docket No. 1880

DECLARATION OF C. DOUGLASS LOCKE, Ph.D.

I. Introduction

1. I, C. Douglass Locke, Ph.D., have been retained by Plaintiffs since October 15, 2007, as a technical expert in this matter. The opinions expressed are my own and I have personal knowledge of the facts stated in this declaration. If I am called as a witness, I could testify competently to the facts and opinions in this declaration.

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II. Qualifications

2. I am a full-time consultant with a variety of clients including the United States Office of the Secretary of Defense, the Jet Propulsion Laboratory, Raytheon Corporation, and Sun Microsystems, involved primarily in embedded systems such as industrial controls, military, aerospace, and telecommunications systems. I have an extensive background in areas such as performance, architecture, design, implementation, and deployment of embedded and real-time systems and software, related international standards, computer language issues (e.g., C, C++, Java, and Ada), software engineering maturity, and software organization.

3. From January 2000 to February 2004, I served as the Vice President of Technology for TimeSys Corporation, a producer of embedded Linux operating system distributions and software development tools. In this position, I had responsibility for defining the technology base for the corporation and extending it to meet customer requirements. In addition, I served as a key consultant and instructor for TimeSys' critical projects and classes, and supporting key customers with systems and software design and code analysis.

4. From August 1998 to January 2000, I served as the Chief Scientist of the Lockheed Martin Systems Solutions organization. My responsibilities there were to define the software and systems architecture for Lockheed Martin's effort to assist major industries worldwide such as automotive and medical device companies who are transitioning from mainframe-based, "stovepipe" application architectures to distributed architectures. In addition to my work with major commercial customers, I also consulted extensively for

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major Lockheed Martin projects across the corporation performing reviews of architecture, design, and code (including C, C++, Ada, and Java).

5. From June 1996 to August 1998, I was the Chief Scientist of Lockheed Martin's Software & Systems Resource Center (SSRC). My responsibilities there centered primarily on systems and software consulting across the entire Lockheed Martin Corporation, leading and participating in program reviews and audits covering systems and software architecture, design, coding standards, and code reviews of critical components, reviewing and updating the SSRC's educational offerings, teaching (e.g., Real-Time Systems Analysis, and Object Oriented Real-Time Architecture), as well as guiding technology dissemination activities at the SSRC.

6. I have authored numerous papers on embedded real-time systems, database technology, and programming languages for real-time systems. I have also served with various international standardization efforts including the Real-Time Specification for Java, the Portable Operating System Interface (POSIX), the Real-Time Common Object Request Broker Architecture and the Real-Time Universal Modeling Language.

7. I received a B.A. in Physics from Kalamazoo College in 1965 and a Ph.D. in Computer Science from Carnegie Mellon University in 1986.

III. Overview of Materials Considered

8. I have reviewed the 6,470,399 patent and the 6,895, 449 patent.

IV. Comments on Device Drivers

9. A typical personal computer includes the basic computer itself, and usually some additional devices that are attached to the computer, such as, printers, disk drives, monitors, keyboards, and other components. These components are known collectively as "hardware."

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10. A personal computer also includes both optional and mandatory computer programs in order to operate. An example of a required computer program includes the operating system for the computer (e.g., Windows XP, Mac OS X, or Linux), while an example of an optional computer program is an application program such as Microsoft Word, or Adobe Photoshop. These computer programs are collectively known as “software.”

11. While hardware and software are often considered separate disciplines, the two must work together for the computer to run.

12. Certain computer programs are written for the purpose of allowing high-level software, such as Adobe Photoshop, or an operating system’s file browser, to talk to (and listen to) hardware, such as a hard disk drive. These programs are called “device drivers,” or simply “drivers” as applied to computer software. A driver translates generic commands (such as to “read” or “write” a file) from high-level computer programs into a sequence of very specific commands that a particular hardware device can understand (such as “seek” or “load register”).

13. Every hardware device must have one or more corresponding drivers. Typically, adding a new hardware device means that the user must also modify the software by installing a new driver.

V. Comments on Customary Devices

14. When attaching a new hardware device to a computer, one of ordinary skill in the art of the Tasler patents would understand that a hardware device is “customary” in a computer when the computer and its software that was provided with it (including the operating system) recognizes the new device and provides driver support for it automatically,

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and does not require any manual intervention to install any new software even though the new device has been added.

15. When adding a new device requires installing a new driver (i.e., it is not a customary device), it is not uncommon for the new driver to cause system crashes because drivers have special access to the sensitive internals of the operating systems of the computers. For example, it is well known in the industry that the majority of crashes of the Windows operating system results from errors in device drivers rather than errors in Windows.

16. A system crash is when a computer's operating system stops working. A crash may appear in several forms, such as freezing the system or a blue screen (commonly called the Blue Screen of Death). Typically, to recover from a system crash the computer must be completely reset, or turned off and turned on again.

17. When a computer is experiencing system crashes, a common troubleshooting technique is to uninstall drivers, starting with the most recently installed driver, because of the likelihood that a driver is the source of the problem. Uninstalling conflicting drivers often restores the reliability of the computer after the crash.

18. Hard disk drives are very common in computers, and have been since 1983, long before the filing of the first Tasler patent application in 1997. A hard drive contains one or more magnetically surfaced discs rotating rapidly, with read/write heads positioned very close to the magnetic surfaces, and with the information remaining persistently on the disc surface. Today, hard disk drives are ubiquitous to computer operation. As a result, drivers for hard disk drives are known to be very fast, very reliable, and supplied with virtually all computers. Thus, the hard disk drive is a clear example of a customary device.

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VI. Comments on Interface Devices

19. Digital cameras may have one or more of several different sensors. Some cameras have CCD image sensors and some have CMOS image sensors for capturing picture data. Image resolution for the image sensors may range from less than one megapixel to more than 10 megapixels. Some digital cameras have microphones for recording sound; others do not.

20. Notwithstanding the variety of sensors which may be found on a digital camera, and the variety of data that they acquire, there is always a portion of the camera responsible for taking the data acquired by the sensors, transforming it into a form usable by a host computer, and making it available to a host computer. That portion of a modern-day digital camera is an interface device.

21. The task of installing new drivers when new devices are connected, and getting the drivers to work is inconvenient and sometimes difficult, especially for persons who are not skilled in computer design and programming.

22. Installing new drivers typically requires a software disk. The disk (usually a Compact Disk or CD) is inserted into the computer which brings up an installation window on the display. Usually, the user must then select one of several options about what should be installed, then the installation takes place, and usually the computer must be re-booted afterward before the driver can be used. If one is attempting to use a hardware device on a computer which lacks the proper driver, communications with the hardware device is generally impossible unless the original installation disk is available. For this reason, some modern hardware, such as a digital camera, will be designed to use a generic computer

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connection such as a Universal Serial Bus (USB), and will present themselves to the computer as a hard disk drive, so there will be no need to install a new driver.

23. When a hard disk drive is attached to a USB port on a personal computer, the disk drive identifies itself as "Mass Storage Class" device. One of ordinary skill in the art would understand that a hard disk drive is the most common example of a mass storage device.

24. Present-day personal computers that detect the attachment of a "Mass Storage Class" USB device use one or more standard drivers to communicate with the Mass Storage Class device. For example, a PC using Windows XP for an operating system communicates with hard disk drives by means of Microsoft standard software drivers, such as disk.sys and PartMgr.sys that are included with the Windows XP operating system. If such a computer detects the attachment of a "Mass Storage Class" USB device, the computer will automatically use those same hard disk drivers to communicate with the device, regardless of whether an actual hard disk drive is present. The computer will also use the standard driver usbstor.sys, which is a general driver for the multipurpose USB interface itself.

25. Some present-day personal computers can also detect the attachment of a USB device representing itself to be a "Still Image Capture Device." Computers that detect the attachment of a USB "Still Image Capture Device" also use one or more standard drivers to communicate with the device. For example, a PC using Windows XP for an operating system communicates with imaging devices, such as scanners, by means of Microsoft standard software drivers, such as usbscan.sys. If such a computer detects the attachment of a USB "Still Image Capture Device," the computer will automatically use those same imaging device drivers to communicate with the device.

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26. In the context of the Tasler patents, a person of ordinary skill would understand a “command interpreter” to mean a portion of the interface device and/or its programming that receives and executes commands or instructions.

27. A device connected to a USB port on a computer will receive inquiry commands with names such as “Get_Descriptor.”

28. Examples of low level data request commands used by these drivers on a USB device when servicing application requests include the SCSI Block Command (“SBC”) set READ commands. In another example, the low level ATAPI command set includes many of the SBC commands, including the READ commands. Also, the Photographic Imaging and Manufacturers Association specification (PIMA 15740:2000) defines low level commands such as “GetObject” (PIMA Commands).

VII. Comments on File Systems

29. In any case, when the operating system has detected a “Mass Storage Class” device, it expects to find and/or create a file system on that device. In virtually all operating systems since about 1990, a file system consists of a set of directories, each of which may contain some number of files and/or other directories arranged hierarchically starting with the lowest level directory or “root directory.”

30. A person of ordinary skill in the art would understand the term “root directory” to refer to a directory which is not contained in another directory.

31. A person of ordinary skill in the art would understand the term “virtual files” to mean files which appear to be present on an emulated disk drive, yet which are not on a rotating magnetic media.

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32. A person of ordinary skill in the art would understand the term “virtual file system” to mean a file system that appears to a computer in the same way that a file system on a conventional hard disk would appear, even though the rotating discs of a conventional hard disk are not present.

33. A person of ordinary skill would understand the term “virtual boot sequence” to mean configuring the interface device to provide information that is consistent with the boot sectors of a hard disk drive having rotating magnetic media. Such sectors may include, for example, a sequence that includes a starting position and a length of a file allocation table (FAT), an indication of a type of the storage device, or a number of sectors of the storage device (‘449 patent, claim 7).

VIII. Comments on a Host Device and Digital Signal Processor

34. The term “host device,” generally means a computer to which hardware devices may be attached, such as Personal Computers (“PCs”) and other host computer systems as described in the patent written description.

35. A Digital Signal Processor is a special type of processor which would be understood by a person of ordinary skill to have a highly parallel, pipeline architecture optimized to perform repetitive operations.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 8 July, 2008


C. Douglass Locke

Landis on Mechanics of Patent Claim Drafting

FIFTH EDITION

ROBERT C. FABER

Incorporating Release No. 6
November 2007
#13139

Practising Law Institute
New York City

G1-8805

§ 2:4

Mechanics of Patent Claim Drafting

How many claims may be presented and how different they must be from each other are discussed in sections 7:1–8:3. For an *example of a complete claims layout*:

I claim:

1. A pencil having . . .
2. A pencil as recited in claim 1, wherein . . . [more detail].
3. A pencil comprising . . . [the most detailed combination acceptable to the applicant].

A claim number is not reused. If a claim is canceled, its claim number is not reused in that patent application. Added claims receive the next number in sequence after the last claim. Claims are not renumbered during application prosecution, except in a continuing application; some claims from a parent application, especially later added claims, may be renumbered in the continuing application. (At conclusion of prosecution, the claims are renumbered by the Patent Office for the patent to be printed.)

Summary

Present multiple claims in a logical order and number them consecutively.

§ 2:4 Preamble

Claims should have “preambles,” or introductory statements, the purposes of which are to indicate the statutory class of the claim (often by implication from the words in the preamble) and to name or define the thing that is to be claimed. It defines the field of the invention claimed. Preambles may be quite long or very short, depending on the type of claim one is using, but a shorter preamble is preferred. For example, in *Karsten Manufacturing Corp. v. Cleveland Golf Co.*,¹² the patent claims all recited “an improved correlated set of iron-type golf-clubs.” The court held that “correlated set” was a claim limitation, although it appeared only in the preamble. It appears that it was an unessential limitation for patentability. Had it been omitted, the claim would have been broader.

The best type of preamble for most claims is simply a general definition of the combination to be claimed, with whatever detail or length is necessary to define what appears in the body of the claim.

12. *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 58 U.S.P.Q.2d (BNA) 1286, 1288 (Fed. Cir. 2001).

Claim Forms and Formats in General

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The preamble and the body of the claim should be consistent one with the other, two parts making up a whole. The preamble cannot be written properly until the scope of the claim-to-be is determined, and the preamble should be checked for consistency after the claim has been finished. When a claim is revised or amended, the preamble should be scrutinized for consistency.¹³

One of the best sources for the claim preamble is the title of the invention at the head of the specification. Sometimes that title is modified to conform to the claim preamble. The title of the invention is typically short, and so should be the preamble. But if the claim is to an element or a subcombination of a fuller invention, using the title as the preamble could cause the preamble to be misleading as too encompassing. Further, where the title differs from the claim preamble, the title does not define the claimed invention, as it would be reading a limitation from the specification into the claim.¹⁴

To avoid a too-limited scope preamble, the claim writer might be tempted to merely recite the broad "Apparatus comprising" or use "device" or a similar nonspecific noun. But a too-broad scope preamble is also not good practice, although not improper. Also, the examiner will likely require that a preamble more descriptive of the invention be substituted.

The preamble should focus on the actual subject or field of the invention and not cover too broad a field, if inapplicable. For an invention in a bicycle, for example, a preamble that says "vehicle" would appear to be of broader scope than a preamble that says "bicycle." Yet if the invention is clearly directed to a bicycle, there is no benefit to having a preamble "vehicle," which is more encompassing than the invention itself. The preamble should be realistically narrow in scope. Conversely, if the preamble says "bicycle," but the invention is adaptable not only for bicycles but for motorcycles, and if an infringer were later to market a product that had all of the feature limitations in the claim, but that was a motorcycle rather than a bicycle, the infringer might argue that the claim does not reach the accused product because the claim is limited in scope to a bicycle. The preamble must be sufficiently broad to cover the product in the preferred embodiment to which the inventor has directed his attention (bicycle), but also to cover other embodiments, as "two-wheeled vehicles," to which the invention may be directed.

In general, one should avoid any unnecessary limitations or statements anywhere in the broader claims, even in the preamble. For

13. As to the effect of limitations in the preamble, see below and also see section 6:7, on new use claims; preamble limitations.

14. *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 51 U.S.P.Q.2d (BNA) 1161 (Fed. Cir. 1999).

example, in *Bicon, Inc. v. Straumann Co.*,^{14.1} the patentee intended to claim “an emergence cuff” for a dental procedure, but noted in the preamble that the cuff was to be used during placement of an “abutment” on a root. Even though the abutment might have been treated as a workpiece and not a claimed element, the presence of “abutment” in the preamble, as well as its appearance in the body of the claim, converted the abutment to a claimed element. MPEP 2173.05(e) specifically excludes a requirement that the preamble include every critical element in the body of the claim. In the example given, the preamble recited a hanger and a loop, whereas the claim body included as a critical element a linear member. Its absence from the preamble did not render the claim indefinite.

Some practitioners briefly describe an object of the invention in a preamble (“Apparatus for shaking articles to dislodge impurities”). This is unnecessary, however, as the preamble is preferably a short introduction to the body of the claim. Also, there may be other objects of the invention, and recitation of one may impliedly exclude accomplishment of others when the claim is later interpreted.

Where the invention operates upon a workpiece, some practitioners include relevant details of the workpiece in the preamble (“Apparatus for shaking articles having a soft covering over a plurality of frangible legs . . .”). Usually, description of the workpiece in the preamble is not needed. As shown in *Bicon, Inc. v. Straumann Co.*, the presence of a workpiece in the preamble might cause the claim to be construed in such a way that the element intended to be recited as a workpiece will instead be a necessary element of the claimed combination. Instead, as a particular element of the apparatus acts upon the workpiece, the relevant interaction of the element upon the workpiece is described in the body of the claim, and possibly in a “whereby” clause. Sometimes, however, it is appropriate to describe the workpiece somewhat fully in the preamble as it may not otherwise be easy to comprehend the rest of the claim. That is true more often in a method claim wherein the workpiece or the apparatus used in the method in the body of the claim is introduced in the preamble. In that case, the better choice is to have the fuller preamble. But the claim writer may then have limited the claim scope to the elements in the preamble.¹⁵ An example of an overlong preamble that may have confused the Board of Appeals somewhat appears in *In re Stencel*.¹⁶

14.1. *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 78 U.S.P.Q.2d (BNA) 1267 (Fed. Cir. 2006).

15. *Eaton Corp. v. Rockwell Int'l Corp.*, 323 F.3d 1332, 66 U.S.P.Q.2d (BNA) 1271, 1277 (Fed. Cir. 2003).

16. *In re Stencel*, 4 U.S.P.Q.2d (BNA) 1071 (Fed. Cir. 1987).

On the other hand, the preamble may have to be longer because, in order to understand an invention, one must understand its context. Therefore, sometimes the purpose of the invention is recited in the preamble before the transition word, as in "Apparatus for treating a web to prevent tearing, the apparatus comprising . . ."¹⁷ The title of the invention at the head of the specification may be slightly different, but there is no short claim preamble that does the job.

In composition of matter claims, where the composition may have no recognized name, it may be necessary to describe certain qualities or features of the composition in the preamble in order to clearly explain or understand the elements in the following body of the claim, for example, "A composition having a density of x and a color y with a brightness level not less than z, comprising material a, at least 10% of material b and material c." The elements of the composition are better understood with a fuller preamble. But the specifics in the preamble, between "composition" and "comprising," may alternately be included in a functional or "whereby" clause placed after the elements are recited in the body of the claim.

Long preambles mentioning elements other than the invention itself may make what the subsequent transition word refers to ambiguous (see section 2:5). For example, in "Apparatus for shaking articles to dislodge impurities comprising . . ." clearly, the transition word "comprising" refers back to the apparatus, not the impurities. For clarity, the preamble should repeat the key word of the name of the invention in the preamble before the transition word, as "Apparatus for shaking articles to dislodge impurities, the apparatus comprising . . ."

With the prevalence of the use of dependent claims, any dependent claim should usually cover the same invention as its preceding or parent claim. If the independent claim begins "Apparatus for shaking articles," a following dependent claim should not claim a different apparatus, for example, "A device for containing articles to be shaken, as recited in Claim 1, comprising . . ." A dependent claim includes all of the text of its preceding claims. The dependent claim just described, however, appears to claim a different invention than or less than all of the invention of its preceding claim. Hence, a dependent claim should have the preamble of the previous claim upon which it is dependent, "The apparatus for shaking articles of Claim 1. . . ." If the previous claim is to "bicycle," the dependent claim should not be to "vehicle." Change one or the other claim for consistency.

17. See *Heidelberg Harris, Inc. v. Mitsubishi Heavy Indus., Ltd.*, 56 U.S.P.Q.2d (BNA) 1714, 1719 (Fed. Cir. 2000) (labeled unpublished); *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 1305, 51 U.S.P.Q.2d (BNA) 1161, 1165-66 (Fed. Cir. 1999).

Often the preamble of a dependent claim is shortened to the key word or words, for example, the noun, of the preamble of its preceding independent claim ("The apparatus of Claim 1"). As long as that leaves no ambiguity, the shortened preamble is even preferred.

Claims of different scope are often used to describe different aspects of an entire invention, a combination and a subcombination, a genus and a species, etc. A different preamble may be used for each different claim grouping: "Apparatus for shaking articles . . ." and "Device for containing articles to be shaken . . ." Just make each different invention or aspect of one invention subject to separate claims, each group of claims with a separate preamble.

Jepson claims under Rule 75(e) have a different type of preamble, which is rather lengthy.¹⁸ It includes a name of the invention and then recites the elements of that complete apparatus, process, composition, or article that is in the prior art.¹⁹ This is a special situation. Because the preamble of a *Jepson* claim recites elements of a claimed invention and defines not only the context or field of the invention but also its scope,²⁰ an element or limitation that appears only at the start of the preamble is considered a claim element.²¹

The preamble is often the basis used by the PTO to assign the application to a particular Examining Art Unit for review of and action on the application. Preferably, the preamble describes the field of the invention to correctly guide the invention classifiers when the application is filed and initially assigned to an Art Unit. Furthermore, the preamble defines the scope of relevant prior art. Accuracy in the preamble is recommended.

Some case precedents suggest that the content of the preamble does not limit the scope of the claim. However, in *Bell Communications Research, Inc. v. Vitalink Communications Corp.*,²² the court said that the determination is made with reference to the specific claim and there found the preamble element limiting.

The MPEP states at section 2111.02 that the preamble is not given the effect of a limitation unless it breathes life and meaning into the claim.²³ Repeated references in the specification to liners as "blown-film"

18. See *infra* section 6:8.

19. M.P.E.P. § 608.01(m).

20. *Epcon Gas Sys., Inc. v. Bauer Compressors, Inc.*, 279 F.3d 1022, 61 U.S.P.Q.2d (BNA) 1470 (Fed. Cir. 2002).

21. *Rowe v. Dror*, 42 U.S.P.Q.2d (BNA) 1550, 1553 (Fed. Cir. 1997).

22. *Bell Commc'ns Research, Inc. v. Vitalink Commc'ns Corp.*, 55 F.3d 615, 34 U.S.P.Q.2d (BNA) 1816 (Fed. Cir. 1995).

23. *Intirtool Ltd. v. Texar Corp.*, 369 F.3d 1289, 70 U.S.P.Q.2d (BNA) 1780 (Fed. Cir. 2004); *Catalina Mktg. Int'l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 62 U.S.P.Q.2d (BNA) 1781 (Fed. Cir. 2002); *Griffin v. Bertina*, 285 F.3d 1029, 62 U.S.P.Q.2d (BNA) 1431 (Fed. Cir. 2002).

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liners, including in the preferred embodiment, and in each claim, made “blown-film” in the preamble a substantive claim limitation, as it gave life, meaning, and vitality to the claims.^{23.1} Phraseology in the preamble that limits the structure must be given weight. See the cases discussed in that section of the Manual.²⁴

The Federal Circuit recently restated the rule:

[T]he preamble simply states the intended use or purpose of the invention. . . . Such a preamble usually does not limit the scope of the claim unless the preamble provides antecedents for ensuing claim terms and limits the claim accordingly.²⁵

When a term (“communication system”) appears in the preamble, but not in the body of the claim, and the court determines that the term does not give “life, meaning or vitality” to the claim, then its absence from an accused device does not avoid infringement of the claim.²⁶

In *Bard*, the preamble provided antecedents by reciting the structure into which needles fit, and the claim was not anticipated or obvious over prior art, which lacked the preamble features. The preamble features saved the claim validity, but those same elements narrow the scope of the claim to be asserted against infringements.

In *Bicon, Inc. v. Straumann Co.*,²⁷ the “abutment” in the preamble was also recited in elements of the same claim after the transition, and the court construed the claim such that the abutment was a claim element, not a field of use or a workpiece.

In *Pitney Bowes, Inc. v. Hewlett-Packard Co.*,^{27.1} the intended purpose of the invention stated in the preamble as “producing on a photoreceptor an image of generated shapes made up of spots” was held not to be a mere statement of intended field of use, but was so

23.1. Poly-America LP v. GSE Lining Tech., Inc., 383 F.3d 1303, 72 U.S.P.Q.2d (BNA) 1685 (Fed. Cir. 2004).

24. See also *Corning Glass Works v. Sumitomo Elec. U.S.A., Inc.*, 868 F.2d 1251, 1257, 9 U.S.P.Q.2d (BNA) 1962 (Fed. Cir. 1989); *In re Burke, Inc.*, 786 F. Supp. 1537, 22 U.S.P.Q.2d (BNA) 1368, 1371 (C.D. Cal. 1992).

25. *C.R. Bard, Inc. v. M3 Sys., Inc.*, 157 F.3d 1340, 48 U.S.P.Q.2d (BNA) 1225, 1230–31 (Fed. Cir. 1998), *reh’g denied*, 161 F.3d 1380, 49 U.S.P.Q.2d (BNA) 1319 (Fed. Cir. 1998), *cert. denied*, 119 S. Ct. 1804 (1999). See *Gerber Garment Tech, Inc. v. Lectra Sys., Inc.*, 916 F.2d 683, 688–89, 16 U.S.P.Q.2d (BNA) 1436, 1441 (Fed. Cir. 1990); *Heidelberg Harris, Inc. v. Mitsubishi Heavy Indus., Ltd.*, 56 U.S.P.Q.2d (BNA) 1714, 1719–20 (Fed. Cir. 2000) (labeled unpublished); *Allen Eng’g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 63 U.S.P.Q.2d (BNA) 1769, 1774 (Fed. Cir. 2002).

26. *NTP, Inc. v. Research in Motion Ltd.*, 261 F. Supp. 2d 423, 67 U.S.P.Q.2d (BNA) 1574 (E.D. Va. 2002).

27. *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 78 U.S.P.Q.2d (BNA) 1267 (Fed. Cir. 2006).

27.1. *Pitney Bowes, Inc. v. Hewlett-Packard Co.*, 182 F.3d 1298, 51 U.S.P.Q.2d (BNA) 1161 (Fed. Cir. 1999).

intimately meshed with the remaining claim language that the preamble and the remainder of the claim were to be construed as one unified internally consistent recitation of the invention.^{27.2}

In *MBO Laboratories, Inc. v. Becton, Dickinson & Co.*,^{27.3} the term “immediately,” used to indicate time in the claim preamble, was deemed an essential feature of the structure claimed, so the time element was considered in construing the claims having that word in the preamble, but not other claims from which that word was absent.

In *Eaton Corp. v. Rockwell Int’l Corp.*,²⁸ the claim preamble of a method claim had a detailed description of structure that performs the recited method steps. The court there found that the claim was an example of the drafter’s using both the preamble and the body of the claim to define the invention, and the preamble was given limiting effect.

Another example is found in *Jansen v. Rexall Sundown, Inc.*,^{28.1} wherein the preamble was to a method of “treating or preventing” pernicious anemia and the body of the claim recited that the treatment is provided “to a human in need thereof.” The Court said that the preamble sets forth the objective of the method, the body of the claim directs on whom the method be performed. Therefore, the body of the claim gives meaning to the preamble’s statement of purpose, making the preamble not merely a statement of effect that may or may not be appreciated. This is the reverse of the normal reasoning for considering the preamble as a limitation to be met, that is, here the body of the claim gives life and meaning to the preamble.

Where the preamble recites “A method for treating sunburn” and the body of the claim says “topically applying to the skin sunburn a fatty acid . . .,” the claim scope was limited to the purpose stated in the preamble, and the court concluded the claim was directed to a new use for the claimed substance.^{28.2} This is an example of using a preamble to intentionally limit claim scope. One does this in a new use claim^{28.3} to distinguish from the previous use. Also, where the prior art shows the body of the claim in a different context than the

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- 27.2. *On Demand Mach. Corp. v. Ingram Indus., Inc.*, 442 F.3d 1331, 78 U.S.P.Q.2d (BNA) 1428 (Fed. Cir. 2006)(preamble is limiting as it states the framework of the invention).
 - 27.3. *MBO Labs., Inc. v. Becton, Dickinson & Co.*, 474 F.3d 1323, 81 U.S.P.Q.2d (BNA) 1661 (Fed. Cir. 2007).
 - 28. *Eaton Corp. v. Rockwell Int’l Corp.*, 323 F.3d 1332, 66 U.S.P.Q.2d (BNA) 1271, 1277 (Fed. Cir. 2003).
 - 28.1. *Jansen v. Rexall Sundown, Inc.*, 342 F.3d 1329, 68 U.S.P.Q.2d (BNA) 1154 (Fed. Cir. 2003).
 - 28.2. *Perricone v. Medicis Pharm. Corp.*, 432 F.3d 1368, 1378–79, 77 U.S.P.Q.2d (BNA) 1321 (Fed. Cir. 2005).
 - 28.3. Section 6:7, *infra*.

present invention, a limiting preamble may cover the invention and also avoid the claim reading on the prior art.

A statement of the purpose of the invention in the preamble can be nonlimiting, as in "A method for *reducing hematologic toxicity* in a cancer patient," because it states a purpose and the claim can be infringed even if the purpose was not always achieved.²⁹

But the opposite may be true in a particular case. In *Griffin v. Bertina*,³⁰ the Federal Circuit said that a claim preamble has the import that the claim as a whole suggests. The preamble is directed to diagnosing an increased risk from a genetic defect that causes thrombosis. Diagnosis was therefore the object of the invention claimed. Performing the steps without the objective in the preamble would be an empty exercise. The preamble was essential.

In *Catalina Marketing Int'l, Inc. v. Coolsavings.com, Inc.*,³¹ the Federal Circuit held that the preamble limitation "located at pre-designated sites such as consumer stores" merely states an intended use for the claimed system and is not a claim limitation. The claimed system is structurally completely claimed in the body of the claim, while the preamble only states the purpose, benefits or intended use of the invention. Infringement was found even though the accused method would be performed at any Internet-accessible computer and not only at "consumer stores" as in the preamble. (Note the presence of "such as" in the preamble, which would be indefinite had it appeared in the body of the claim or in a preamble that is a claim element.)

Yet in *Ex parte Futo*,³² the Board found that the claimed use of a wrench recited in the preamble for rotating plastic slip nuts, recited an environment that avoided a prior art soda bottle wrench being prior art to render the invention obvious.

The Federal Circuit has identified guideposts for identifying limiting preamble language:

- (a) a *Jepson* claim uses the preamble to define the invention;
- (b) dependence on a phrase in dispute to provide an antecedent basis indicates reliance on the preamble;
- (c) the preamble is needed to understand elements in the claim body;

29. *Bristol-Myers Squibb Co. v. Ben Venue Labs., Inc.*, 246 F.3d 1368, 58 U.S.P.Q.2d (BNA) 1508, 1513 (Fed. Cir. 2001).

30. *Griffin v. Bertina*, 285 F.3d 1029, 62 U.S.P.Q.2d (BNA) 1431, 1434 (Fed. Cir. 2002).

31. *Catalina Mktg. Int'l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 62 U.S.P.Q.2d (BNA) 1781 (Fed. Cir. 2002).

32. *Ex parte Futo*, 59 U.S.P.Q.2d (BNA) 1955 (B.P.A.I. 2000).

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- (d) the specification emphasizes additional elements as important;
- (e) clear reliance on the preamble to avoid prior art during application prosecution.

In *Invitrogen Corp. v. Biocrest Mfg., LP*,³³ the applicant amended “E. coli cells” in the claim preamble to “E. coli cells of improved competence,” which should not be viewed as structural and might be viewed as stating a purpose of the invention. But the Federal Circuit said those words were added to avoid prior art and thus infringement required a particular improvement level. The recited claim elements were not changed but the preamble narrowed the claim scope.

In *In re Cruciferous Sprout Litigation*,³⁴ the court found the preamble words “rich in glucosinolates” and other words in the preamble to have been relied on to avoid prior art as helping to define the invention.³⁵

In *Schumer v. Laboratory Computer Systems, Inc.*,³⁶ the preamble of a method claim described features that necessarily exist in any coordinate system for a digitizer, but did not describe how the device operates with respect to those features. The body of the claim details the functional attributes of the device that performs the methods. The preamble was deemed superfluous.

In *Intirtool, Ltd. v. Texar Corp.*,^{36.1} the court said that

if the body of the claim “describes a structurally complete invention such that deletion of the preamble phrase does not affect the structure or steps of the claimed invention,” the preamble is generally not limiting unless there is “clear reliance on the preamble during prosecution to distinguish the claimed invention from the prior art.” . . . Here, the preamble does not recite any “additional structure or steps underscored as important by the specification”

These are tests for the preamble having to be considered as a limiting claim element.

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- 33. *Invitrogen Corp. v. Biocrest Mfg., LP*, 327 F.3d 1364, 66 U.S.P.Q.2d (BNA) 1631 (Fed. Cir. 2003).
 - 34. *In re Cruciferous Sprout Litig.*, 301 F.3d 1345, 64 U.S.P.Q.2d (BNA) 1202, 1205 (Fed. Cir. 2002).
 - 35. *See Storage Tech. Corp. v. Cisco Sys., Inc.*, 329 F.3d 823, 66 U.S.P.Q.2d (BNA) 1545 (Fed. Cir. 2003).
 - 36. *Schumer v. Lab. Computer Sys., Inc.*, 308 F.3d 1304, 64 U.S.P.Q.2d (BNA) 1832 (Fed. Cir. 2003).
 - 36.1. *Intirtool Ltd. v. Texar Corp.*, 369 F.3d 1289, 1295, 70 U.S.P.Q.2d (BNA) 1780, 1784 (Fed. Cir. 2004)[citations omitted].

These cases show different treatments of preamble recitations. But if the preamble lacks unnecessary words, there is no interpretation issue raised.

There is nothing to gain by having an overlong preamble, with many elements recited. Each may become a claim limitation which a later copyist could avoid using.

Recommended preambles for different types of claims are set out in subsequent parts of this treatise.

Summary

Use descriptive preambles defining the nature of the combination claimed. Do not put unnecessary limitations even in the preamble. Assume every word you write in a claim is critical, and may some day be used against your client, to restrict the scope of his invention.

§ 2:5 Transition from Preamble to Body—"Comprising" and Other Open-Ended Terms

Most ordinary combination claims require a transitional word or phrase between the preamble (naming the thing to be claimed) and the body of the claim (defining what the elements or parts of the thing are). Two recommended forms of transition that can be employed for most claims are the phrases: "which comprises" or "comprising." The choice between the two is immaterial.

The word "comprises" has been construed to mean, in patent law, "including the following elements but not excluding others."³⁷ The claim is "open," not "closed."³⁸ Additional elements in an accused

37. M.P.E.P. § 2111.03; *Moleculon Research Corp. v. CBS, Inc.*, 229 U.S.P.Q. (BNA) 805, 812 (Fed. Cir. 1986).

38. M.P.E.P. § 2111.03; *Burke, Inc. v. Everest & Jennings, Inc.*, 991 F.2d 812, 29 U.S.P.Q.2d (BNA) 1393, 1397 (Fed. Cir. 1993) (unpublished); *Special Metals Corp. v. Teledyne Indus., Inc.*, 219 U.S.P.Q. (BNA) 953 (4th Cir. 1983); *Air Prods. & Chems., Inc. v. Chas. S. Tanner Co.*, 219 U.S.P.Q. (BNA) 223 (D.S.D. 1983); *In re Certain Slide Fastener Stringers*, 216 U.S.P.Q. (BNA) 907 (Ct. Int'l Trade 1981). A patent claim "which uses the term 'comprising,' is an 'open' claim which will read on devices which add additional elements. . . ." *Carl Zeiss Stiftung v. Renishaw PLC*, 945 F.2d 1173, 20 U.S.P.Q.2d (BNA) 1094 (Fed. Cir. 1991); *Abtox, Inc. v. Exitron Corp.*, 43 U.S.P.Q.2d (BNA) 1545, 1548 (Fed. Cir. 1997), *modified on other grounds*, 46 U.S.P.Q.2d (BNA) 1735 (Fed. Cir. 1997); *Genentech, Inc. v. Chiron Corp.*, 112 F.3d 495, 501, 42 U.S.P.Q.2d (BNA) 1608, 1613 (Fed. Cir. 1997); *see also* *T.J. Smith & Nephew Ltd. v. Parke, Davis & Co.*, 871 F.2d 1098, 10 U.S.P.Q.2d (BNA) 1946 (Fed. Cir. 1989); *Berenter v. Quigg*, 737 F. Supp. 5, 14 U.S.P.Q.2d (BNA) 1175 (D.D.C. 1988); *Vehicular Techs. Corp. v. Titan Wheel Int'l, Inc.*, 212 F.3d 1377, 54 U.S.P.Q.2d (BNA) 1841 (Fed. Cir. 2000).

device or method do not avoid such an open claim.³⁹ The clause “comprising . . . a group of first, second, and third blades . . .” covered a four-blade razor. Both “comprising” and “group of” are open-ended claim terms. This was held despite the specification’s repeatedly teaching that the invention was in a three-blade razor.

“Comprises” not only permits additional elements besides those specifically recited, it does not enable removal of elements specifically recited.^{39.1} All elements recited in the claim are construed as having to be present.

“Comprising” and “consists” may both be present in a claim:

A purified oligonucleotide comprising at least a portion of . . .
wherein said portion consists of . . .

The Federal Circuit held that “the term ‘consists’ limits the ‘said portion’ language to the subsequently recited numbered nucleotides, but the earlier term ‘comprising’ means that the claim can include that portion plus other nucleotides.”^{39.2}

When “comprising” is used as a transition word in a method claim, that claim encompasses a method including additional steps to those expressly recited in the claim, including a step preceding or following one of the steps expressly recited.⁴⁰ Further, “comprising the steps of” does not convert the claim element to step-plus-function form under section 112, para 6.^{40.1}

Other words, less often used, have been given the same meaning in patent claim interpretation as “comprising”.^{40.2} “including,”⁴¹

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- 39. Gillette Co. v. Energizer Holdings, Inc., 405 F.3d 1367, 74 U.S.P.Q.2d (BNA) 1586 (Fed. Cir. 2005); Power Mosfet Techs. LLC v. Siemens AG, 378 F.3d 1396, 72 U.S.P.Q.2d 1129 (Fed. Cir. 2004); Smith & Nephew, Inc. v. Ethicon, Inc., 276 F.3d 1304, 61 U.S.P.Q.2d (BNA) 1065 (Fed. Cir. 2002); Dow Chem. Co. v. Sumitomo Chem. Co., 59 U.S.P.Q.2d (BNA) 1609, 1620 (Fed. Cir. 2001); Vivid Tech, Inc. v. Am. Sci. & Eng’g, Inc., 200 F.3d 795, 811, 53 U.S.P.Q.2d (BNA) 1289, 1301 (Fed. Cir. 1999).
 - 39.1. Power Mosfet Techs. LLC v. Siemens AG, 378 F.3d 1396, 72 U.S.P.Q.2d 1129 (Fed. Cir. 2004).
 - 39.2. *In re* Crish, 393 F.3d 1253, 1257, 73 U.S.P.Q.2d (BNA) 1364 (Fed. Cir. 2004).
 - 40. Invitrogen Corp. v. Biocrest Mfg., LP, 327 F.3d 1364, 66 U.S.P.Q.2d (BNA) 1631 (Fed. Cir. 2003).
 - 40.1. Cardiac Pacemakers, Inc. v. St. Jude Med., Inc., 381 F.3d 137, 72 U.S.P.Q.2d (BNA) 1333 (Fed. Cir. 2004).
 - 40.2. M.P.E.P. § 2111.03.
 - 41. San Disk Corp. v. Memorex Prods. Inc., 415 F.3d 1278, 75 U.S.P.Q.2d (BNA) 1475 (Fed. Cir. 2005); *In re* Certain Slide Fastener Stringers, 216 U.S.P.Q. (BNA) 907 (Ct. Int’l Trade 1981); Burke, Inc. v. Everest & Jennings, Inc., 991 F.2d 812, 29 U.S.P.Q.2d (BNA) 1393, 1397 (Fed. Cir. 1993) (unpublished).

"having,"⁴² "containing,"^{42.1} "characterized by" or "characterized in that" (which is a transition used in claims in non-U.S. patent applications by foreign attorneys), and even "wherein."⁴³ However, "comprising" is recommended simply because it has become a standardized word of the patent art. "Comprised of" is also an acceptable variation of "comprising," although a district court misconstrued it as closed-ended, and the Federal Circuit corrected that.^{43.1}

*Lampi Corp. v. American Power Products, Inc.*⁴⁴ illustrates the risk a claim writer takes by using a word, here "having" rather than "comprising," as an open-ended transition word.^{44.1} The court spent much time analyzing the specification to see if the word "having" was open-ended in a claim. The court also relied on a dependent claim that used the word "comprising" as a basis for finding the "having" in the parent claim open-ended. So, why take a risk in claiming? The Federal Circuit yet again construed "having,"⁴⁵ saying that word does not presumptively "open" the body of the claim. It is not as strongly open a word as "comprising." The court therefore had to examine the claim in context to determine the limits of "having."

For example, a claim to "A writing implement *comprising* a pencil with an eraser fastened at one end" covers any type of eraser-tipped pencil: wood, mechanical, etc.; with or without a clip to hook it in one's pocket; and whether or not additional features or additions are patentable to later inventors. Thus, in patent shorthand, "the combination comprising A + B (individual elements or parts)" covers A + B + C . . . or A + B' (a variation of element B falling under the claim definition). In general, the technique of writing broad claims is to claim the minimum number of elements that will function in the combination, each defined as broadly as the prior art and claim drafting doctrines will allow. In that

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- 42. *In re Certain Slide Fastener Stringers*, 216 U.S.P.Q. (BNA) 907 (Ct. Int'l Trade 1981); *Compro-Frank Corp. v. Valk Mfg. Co.*, 216 U.S.P.Q. (BNA) 531 (E.D. Pa. 1982). *But see* *Lampi Corp. v. Am. Power Prods., Inc.*, 228 F.3d 1365, 56 U.S.P.Q.2d (BNA) 1445, 1453-54 (Fed. Cir. 2000).
 - 42.1. *Mars, Inc. v. H.J. Heinz Co.*, 377 F.3d 1369, 71 U.S.P.Q.2d (BNA) 1837 (Fed. Cir. 2004). Some claims had "containing at least . . ." while others had "containing." The latter claims were still considered to be open-ended.
 - 43. *Ex parte Grasselli*, 231 U.S.P.Q. (BNA) 395 (B.P.A.I. 1983).
 - 43.1. *CIAS v. Alliance Gaming Corp.*, ___ F.3d ___, ___ U.S.P.Q.2d (BNA) ___, 2007 U.S. App. LEXIS 22807 (Fed. Cir. Sept. 27, 2007).
 - 44. *Lampi Corp. v. Am. Power Prods., Inc.*, 228 F.3d 1365, 56 U.S.P.Q.2d (BNA) 1445 (Fed. Cir. 2000).
 - 44.1. M.P.E.P. § 2111.03.
 - 45. *Crystal Semiconductor Corp. v. TriTech Microelectronics Int'l, Inc.*, 57 U.S.P.Q.2d (BNA) 1953, 1958-59 (Fed. Cir. 2001).

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manner, the main “point of the invention,” or “inventive concept,”⁴⁶ should be crystallized in concrete terms.

Comprising or including enables part of or a subset of group of elements that are present, either in the patent disclosure or in an accused product or method, to have the claimed characteristic(s) while another subset of the same elements do not have the claimed characteristic(s).^{46.1}

However, despite use of “comprising” as the transition, a claim can be interpreted such that all of the elements of one type have a claimed characteristic, although the claim recites that a plurality of those elements have that characteristic—suggesting to the patent owner that some of those elements in an accused product may lack that characteristic yet still be within the claim.⁴⁷

Some form of the word “comprise” is practically always used for mechanical or method combination claims.

Although the foregoing discussion was directed at transitions following a preamble, it applies to transitional phrases throughout a claim, wherein any claim element is defined as comprising other elements. The foregoing does not apply to elements that are not transition words. They can be open-ended as well, meaning that they are not limited to the specific components or elements recited for that word. “Mixture” is not always limited to the specific component parts thereof expressly recited, but may include others because the claim has an open-ended transition word.^{47.1}

Summary

Use the open-ended transition like “comprising” or “which comprises,” except in very unusual cases.

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- 46. Note, some attorneys sometimes speak loosely of “the invention,” meaning the point of novelty or inventive concept, rather than merely the technical subject matter to be patented, as the word “invention” is defined in the statute. This double or triple meaning for the word “invention” is confusing and should be avoided.
 - 46.1. In *San Disk Corp. v. Memorex Prods. Inc.*, 415 F.3d 1278, 75 U.S.P.Q.2d (BNA) 1475 (Fed. Cir. 2005), some memory cells had the claimed characteristics while others did not, and that arrangement was covered by the claim because the transition word was “includes.”
 - 47. *Tex. Instruments, Inc. v. United States Int’l Trade Comm’n*, 26 U.S.P.Q.2d (BNA) 1018, 1024 (Fed. Cir. 1993).
 - 47.1. *Mars, Inc. v. H.J. Heinz Co.*, 377 F.3d 1369, 71 U.S.P.Q.2d (BNA) 1837 (Fed. Cir. 2004).

§ 2:7

*Mechanics of Patent Claim Drafting***§ 2:7 Body of the Claim**

The body of a combination claim, meaning the part that follows the preamble and the transitional phrase, comprises:

- a. recitation of the “elements” of parts of the combination; and
- b. description of how the elements cooperate with one another structurally, physically, or functionally, to make up the operative combination recited in the preamble. Where no mode of cooperation among any element and any of the other elements is described, the claim is not to a combination, is at best to an aggregation, and is improper in form.

The body of the claim is written in narrative expository prose, following the single sentence rule. The claim must be limited to a description of the technical subject matter, and surplus or laudatory statements, such as “novel,” are not permitted, nor are statements of objects or advantages. Thus a claim to “A combination steam and dry iron comprising [A, B, and C], thus to iron clothes more effectively than heretofore” would be objectionable because of its last clause.

In terms of English grammar, the body of a combination claim is a series: A and B; A, B, and C; etc. The letters A, B, and C conventionally stand for the “elements” of the claim, by which is meant the main structures, steps, parts, or ingredients that form the machine, process, article of manufacture, or composition of matter recited in the preamble.⁶⁸

In the rare case of a single element claim (as distinguished from a combination claim), the single element, be it a mechanism, step, article or composition, is merely described.⁶⁹ Note also the prohibition against single “means” claims,⁷⁰ where the only element of the claim is means performing a function. Since practically all claims are to combinations of one sort or another, this book will deal primarily with combination claims except where specifically noted.

Of course, clear and intelligible wording should be used in describing the elements and how they cooperate or function, to make sure the claim “particularly points out” the invention and “distinctly claims” it (section 1:1). Avoid “ambiguities, vague or clumsy expressions, and unnecessary repetition of language.” This latter advice is from the Patent and Trademark Office’s guidelines in reviewing claims written by applicants for admission to practice before the Patent and Trademark Office in a written examination known as the Agent’s Exam.

68. See, e.g., Claim 1 in chapter 3.

69. See, e.g., Claim 5 in section 4:7.

70. Discussed in section 3:25.

Summary

The body of the claim lists the main elements of the combination (parts, steps, chemicals, etc.) and tells how they work together or are related to each other. Most claims are directed to combinations of two or more elements. Stick to technical description, and eschew unnecessary, redundant, surplus, and any laudatory statements. Tell what the invention is, not how good it is. The claim must be readily understandable, and clear as to what it covers.

§ 2:8 Format and Punctuation; Subparagraph Form

Since a combination claim is a grammatical series, if three or more elements (A, B, and C) are described, which coincide with the clauses of the series, they must be set off by commas at least. Even with two-element claims, punctuation should be used unless the first element contains very few words, so that it is clear where the description of the second element starts. As in any writings, semicolons should be used to set off the clauses whenever one or more of the clauses contains internal punctuation. Other punctuation, such as parentheses (except for reference numerals⁷¹), dashes, etc., is not ordinarily needed or used in claims, although there is no reason expressed in the rules or in the manual why such techniques should not be used in appropriate cases.

The single-paragraph form of claim (see Claim 1A, section 3:1.1), with commas between the elements and no indentation, letters, or numerals to identify the elements, is the form that was used almost exclusively by practitioners in the past. It is still accepted by the Patent and Trademark Office, and may be preferable for very simple claims, such as a five-line claim with only two or three elements.

Because claims are often complex and difficult to follow, various other formats are being widely used today to make claims easier to follow and understand. The Patent and Trademark Office is known to favor most such attempts at clarity, and therefore it is recommended that some format other than a single paragraph be adopted.

One such format, the subparagraph or tabular form, is strongly favored by the Patent and Trademark Office and is recommended for most if not all claims.⁷² Even further indentations within a subparagraph, like subsubparagraphs, are recommended in MPEP section 608.01(m) to further segregate subcombination or related steps (see Claim 1, section 3:1.1). This form actually helps the apprentice claim

71. M.P.E.P. § 608.01(m).

72. See M.P.E.P. § 608.01(m).

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American National Standard
for Information Technology

SCSI Block Commands - 2 (SBC-2)

Secretariat
Information Technology Industry Council

Approved mm.dd.yy

American National Standards Institute, Inc.

ABSTRACT

This standard specifies the functional requirements for the SCSI Block Commands - 2 (SBC-2) command set. SBC-2 permits SCSI block logical units such as rigid disks to attach to computers and provides the definition for their use.

This standard maintains a high degree of compatibility with the SCSI Block Commands (SBC) command set, INCITS 306-1998, and while providing additional functions, is not intended to require changes to presently installed devices or existing software.

American National Standard

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3 Definitions, symbols, abbreviations, keywords, and conventions

3.1 Definitions

3.1.1 additional sense code: A combination of the ADDITIONAL SENSE CODE and ADDITIONAL SENSE CODE QUALIFIER fields in the sense data. See SPC-3.

3.1.2 application client: An object that is the source of SCSI commands. See SAM-3.

3.1.3 byte: A sequence of eight contiguous bits considered as a unit.

3.1.4 cache: A temporary and often volatile data storage area outside the area accessible by application clients that may contain a subset of the data stored in the non-volatile data storage area.

3.1.5 check data: Information contained within a redundancy group (see 3.1.37) that may allow lost or destroyed XOR-protected data (see 3.1.46) to be recreated.

3.1.6 command: A request describing a unit of work to be performed by a device server. See SAM-3.

3.1.7 command descriptor block (CDB): The structure used to communicate commands from an application client to a device server. See SPC-3.

3.1.8 cyclic redundancy check (CRC): An error checking mechanism that checks data integrity by computing a polynomial algorithm based checksum. See 4.16.3.

3.1.9 data defect list (DLIST): A list of defects sent by the application client to the device server during a FORMAT UNIT command. See 4.8.

3.1.10 data-in buffer: The buffer identified by the application client to receive data from the device server during the processing of a command. See SAM-3.

3.1.11 data-out buffer: The buffer identified by the application client to supply data that is sent from the application client to the device server during the processing of a command. See SAM-3.

3.1.12 default protection information: Values placed into protection information fields if an application client does not specify specific protection information values.

3.1.13 device server: An object within a logical unit that processes SCSI tasks according to the rules of task management. See SAM-3.

3.1.14 device type: The type of device (or device model) implemented by the device server as indicated by the PERIPHERAL DEVICE TYPE field of the standard INQUIRY data. See SPC-3.

3.1.15 direct-access block device: A device that is capable of containing data stored in blocks that each have a unique logical block address.

3.1.16 domain: An I/O system consisting of a set of SCSI devices that interact with one another by means of a service delivery subsystem. See SAM-3.

3.1.17 error correcting code (ECC): An error checking mechanism that checks data integrity and enables some errors in the data to be corrected.

3.1.18 exclusive-or (XOR): A Boolean arithmetic function on two binary input values that results in an output value of 1 if one and only one of the input values is 1.

3.1.19 extent: A fixed set of logical blocks occupying contiguous logical block addresses on a single logical unit.

3.1.20 field: A group of one or more contiguous bits, a part of a larger structure such as a CDB (see 3.1.7) or sense data (see SPC-3).

3.1.21 format corrupt: a vendor-specific condition in which the application client may not be able to perform read operations, write operations, or verify operations. See 4.6.

3.1.22 grown defect list (GLIST): All defects sent by the application client to the device server. See 4.8.

3.1.23 hard reset: A condition resulting from the events defined by SAM-3 in which the SCSI device performs the hard reset operations described in SAM-3, this standard, and other applicable command standards (see table 10 in 5.1).

3.1.24 I_T nexus loss: A condition resulting from the events defined by SAM-3 in which the SCSI device performs the I_T nexus loss operations described in SAM-3, this standard, and other applicable command standards (see table 10 in 5.1).

3.1.25 logical block: A set of data bytes accessed and referenced as a unit.

3.1.26 logical block address (LBA): The value used to reference a logical block.

3.1.27 logical unit certification list (CLIST): Defects detected by the device server during an optional certification process performed during the FORMAT UNIT command. See 4.8.

3.1.28 logical unit reset: A condition resulting from the events defined by SAM-3 in which the logical unit performs the logical unit reset operations described in SAM-3, this standard, and other applicable command standards (see table 10 in 5.1).

3.1.29 media: Plural of medium.

3.1.30 medium: The material on which data is stored (e.g., a magnetic disk).

3.1.31 non-volatile cache: Cache that retains data through power cycles.

3.1.32 non-volatile medium: A physical storage medium that retains data written to it for subsequent read operations through power cycles (e.g., a disk within a device that stores data as magnetic field changes that do not require device power to exist).

3.1.33 power cycle: Power being removed followed by power being applied to a SCSI device.

3.1.34 power on: A condition resulting from the events defined by SAM-3 in which the SCSI device performs the power on operations described in SAM-3, this standard, and other applicable command standards (see table 10 in 5.1).

3.1.35 primary defect list (PLIST): The list of defects that are considered permanent defects. See 4.8.

3.1.36 protection information: Fields appended to each logical block that contain a cyclic redundancy check (CRC), an application tag, and a reference tag.

3.1.37 redundancy group: A grouping of XOR-protected data (see 3.1.46) and associated check data (see 3.1.5) into a single type of data redundancy (see SCC-2). This standard only supports the XOR (see 3.1.18) type of redundancy.

3.1.38 sense data: Data describing an error or exceptional condition that a device server delivers to an application client in association with CHECK CONDITION status. See SPC-3.

3.1.39 sense key: The contents of the SENSE KEY field in the sense data. See SPC-3.

3.1.40 status: One byte of response information sent from a device server to an application client upon completion of each command. See SAM-3.

3.1.41 storage array controller: Any combination of an initiator and application clients (see SAM-3) that originates SCSI commands, converts input LUNs to output LUNs, and converts input LBAs to output LBAs. A storage array controller organizes a group of direct-access block devices into various objects (e.g., redundancy groups and volume sets). See SCC-2.

3.1.42 user data: Data contained in logical blocks that is not protection information.

3.1.43 volatile cache: Cache that does not retain data through power cycles.

3.1.44 volatile medium: Medium that does not retain data written to it for a subsequent read operation through power cycles (e.g., a silicon memory device that loses data written to it if device power is lost).

3.1.45 XOR operation: Performing an XOR (see 3.1.18) bitwise on two identical-sized multiple-bit input values (e.g., the current value of a logical block and the new value for that logical block). In a storage array implementing a redundancy group (see 3.1.37), the XOR operation is used in error correction algorithms and may be performed by the storage array controller (see 3.1.41) or by the direct-access block devices (see 3.1.15). See 4.14.

3.1.46 XOR-protected data: Logical blocks, including user data and protection information, if any, that are part of a redundancy group (see 3.1.37).

3.2 Symbols and abbreviations

See table 1 for abbreviations of standards bodies (e.g., ISO). Additional symbols and abbreviations used in this standard include:

Abbreviation	Meaning
CDB	command descriptor block (see 3.1.7)
CRC	cyclic redundancy check (see 3.1.8)
CLIST	logical unit certification list (see 3.1.27)
DLIST	data defect list (see 3.1.9)
ECC	error correcting code (see 3.1.17)
GLIST	grown defect list (see 3.1.22)
I/O	input/output
LBA	logical block address (see 3.1.26)
LSB	least significant bit
LUN	logical unit number
MMC-4	SCSI Multimedia Commands - 4 standard
MSB	most significant bit
PLIST	primary defect list (see 3.1.35)
SAM-3	SCSI Architecture Model - 3 standard
SCSI	Small Computer System Interface family of standards
SCC-2	SCSI-3 Controller Commands - 2 standard
SES-2	SCSI Enclosure Services - 2 standard
SMC-2	SCSI Media Changer Commands - 2 standard
SPC-3	SCSI Primary Commands - 3 standard

XOR exclusive-or (see 3.1.18)

3.3 Keywords

3.3.1 expected: A keyword used to describe the behavior of the hardware or software in the design models assumed by this standard. Other hardware and software design models may also be implemented.

3.3.2 ignored: A keyword used to describe an unused bit, byte, word, field or code value. The contents or value of an ignored bit, byte, word, field or code value shall not be examined by the receiving SCSI device and may be set to any value by the transmitting SCSI device.

3.3.3 invalid: A keyword used to describe an illegal or unsupported bit, byte, word, field or code value. Receipt of an invalid bit, byte, word, field or code value shall be reported as an error.

3.3.4 mandatory: A keyword indicating an item that is required to be implemented as defined in this standard.

3.3.5 may: A keyword that indicates flexibility of choice with no implied preference (equivalent to “may or may not”).

3.3.6 may not: Keywords that indicate flexibility of choice with no implied preference (equivalent to “may or may not”).

3.3.7 need not: Keywords indicating a feature that is not required to be implemented (equivalent to “is not required to”).

3.3.8 obsolete: A keyword indicating that an item was defined in prior SCSI standards but has been removed from this standard.

3.3.9 optional: A keyword that describes features that are not required to be implemented by this standard. However, if any optional feature defined in this standard is implemented, then it shall be implemented as defined in this standard.

3.3.10 reserved: A keyword referring to bits, bytes, words, fields and code values that are set aside for future standardization. A reserved bit, byte, word or field shall be set to zero, or in accordance with a future extension to this standard. Recipients are not required to check reserved bits, bytes, words or fields for zero values. Receipt of reserved code values in defined fields shall be reported as an error.

3.3.11 restricted: A keyword referring to bits, bytes, words, and fields that are set aside for use in other SCSI standards. A restricted bit, byte, word, or field shall be treated as a reserved bit, byte, word or field for the purposes of the requirements defined in this standard.

3.3.12 shall: A keyword indicating a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to this standard.

3.3.13 should: A keyword indicating flexibility of choice with a strongly preferred alternative; equivalent to the phrase “it is strongly recommended.”

3.3.14 vendor-specific: Something (e.g., a bit, field, or code value) that is not defined by this standard and may be used differently in various implementations.

3.4 Conventions

Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in this clause or in the text where they first appear.

Names of commands, status codes, sense keys, and additional sense codes are in all uppercase (e.g., REQUEST SENSE).

Names of fields and state variables are in small uppercase (e.g. NAME). When a field or state variable name contains acronyms, uppercase letters may be used for readability. Normal case is used when the contents of a field or state variable are being discussed. Fields or state variables containing only one bit are usually referred to as the NAME bit instead of the NAME field.

Normal case is used for words having the normal English meaning.

A binary number is represented in this standard by any sequence of digits comprised of only the Western-Arabic numerals 0 and 1 immediately followed by a lower-case b (e.g., 0101b). Underscores or spaces may be included between characters in binary number representations to increase readability or delineate field boundaries (e.g., 0 0101 1010b or 0_0101_1010b).

A hexadecimal number is represented in this standard by any sequence of digits comprised of only the Western-Arabic numerals 0 through 9 and/or the upper-case English letters A through F immediately followed by a lower-case h (e.g., FA23h). Underscores or spaces may be included in hexadecimal number representations to increase readability or delineate field boundaries (e.g., B FD8CFA23h or B_FD8C_FA23h).

A decimal number is represented in this standard by any sequence of digits comprised of only the Western-Arabic numerals 0 through 9 not immediately followed by a lower-case b or lower-case h (e.g., 25).

This standard uses the ISO convention for representing decimal numbers (e.g., the thousands and higher multiples are separated by a space and a comma is used as the decimal point). Table 2 shows some examples of decimal numbers represented using the ISO and American conventions.

Table 2 — ISO and American numbering convention examples

ISO	American
0,6	0.6
3,141 592 65	3.14159265
1 000	1,000
1 323 462,95	1,323,462.95

Lists sequenced by letters (e.g., a) red, b) blue, c) green) show no ordering relationship between the listed items. Lists sequenced by numbers (e.g., 1) red, 2) blue, 3) green) show an ordering relationship between the listed items.

If a conflict arises between text, tables or figures, the order of precedence to resolve the conflicts is text, then tables, and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values.

Notes do not constitute any requirements for implementers.

IEEE Std 100-1996

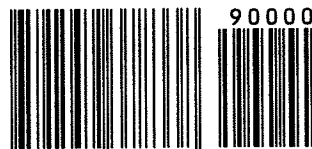
The IEEE Standard Dictionary of Electrical and Electronics Terms

Sixth Edition

**Standards Coordinating Committee 10, Terms and Definitions
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continuum

continuum See: baseline.

contour analysis In optical character recognition, a technique for locating the outline of a character by searching around its exterior edges with a spot of light. (C) 610.2-1987

contoured beam antenna A shaped-beam antenna designed in such a way that when its beam intersects a given surface, the lines of equal power flux density incident upon the surface form specified contours. See also: footprint. (AP) 145-1993

contour encoding An image compression technique in which a region that has a constant gray level is encoded by specifying only its border. (C) 610.4-1990

contouring control system (numerically controlled machines) A system in which the controlled path can result from the coordinated, simultaneous motion of two or more axes. (EEC) [74]

contrast (1) (diode-type camera tube) The ratio of the difference between the peak and minimum values of irradiance to the peak irradiance of an image or specified portion of an image.

$$C = \frac{E_p - E_m}{E_p} \times 100 \text{ (percent)}$$

(2) A legally binding document agreed upon by the customer and supplier. This includes the technical and organizational requirements, cost, and schedule for a product. A contract may also contain informal but useful information such as the commitments or expectations of the parties involved. (ED) 503-1978w

(3) A binding agreement between two parties, especially enforceable by law or similar internal agreement wholly within an organization, for supply of service or for the supply, development, production, operation, or maintenance of a software product. (C/SE) 830-1993

contrast curve (rotating electric machinery) A specified machine characteristic curve that becomes part of the contract. (C/SE) 1062-1993

contract demand (power operations) The demand that the supplier of electric service agrees to have available for delivery. (PE) 11-1980r

contractor (1) (hydroelectric power plants) A device used for repetitive opening and closing operation of an electric circuit, and that has load-current interrupting capability. It has no fault-current interrupting capability. (PE) 858-1993

(2) (metal transmission structures) See also: constructor. (PE/T&D) 951-1988s

(3) (power and distribution transformers) A device for repeatedly establishing and interrupting an electric power circuit. (PE) C57.12.80-1978r

contractual requirements Customer-imposed performance, logistics, and other requirements and commitments governing the scope of software development, delivery, or support. (C/SE) 1074-1995

contrast (1) (image processing and pattern recognition) The difference between the average brightness of two subsets of an image. (C) 610.4-1990

(2) (computer graphics) The relationship between the highest and lowest intensity levels of a display image, usually expressed as the ratio of light to dark. (C) 610.6-1991

(3) (display presentation) The subjective assessment of the difference in appearance of two parts of a field of view seen simultaneously or successively. (Hence: luminosity contrast, lightness contrast, color contrast, simultaneous contrast, successive contrast). See also: photometry; television. (BT) [34], [84]

(4) (electric power systems in commercial buildings) Indicates the degree of difference in light reflectance of the details of a task compared with its background. (IA) 241-1990

contrast control A control, associated with a picture-display device, for adjusting the contrast ratio of the reproduced picture.

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control action Note: The contrast control is normally an amplitude control for the picture signal. In a monochrome-television system, both average luminance and the contrast ratio are affected. In a color-television system, saturation and hue may be affected. See also: television. (EEC/PE) [11]

contrast ratio (1) (television) The ratio of the maximum to minimum luminance values in a television picture or a portion thereof. Note: Generally, the entire area of the picture is applied, but smaller areas may be specified as in detail contrast. (BT) 201-1979r

(2) (amplitude, frequency, and pulse modulation) For any diffraction order, the ratio of the maximum light intensity to the minimum light intensity in the order, so that $C = I_{\max}/I_{\min}$, where C is the contrast ratio. Note: In the limiting case when the depth of modulation is equal to 1, the minimum light intensity is due to background light, so that $C = I_{\max}/I_b$. In the other extreme, when $m = 0$, the contrast ratio is equal to 1. (UFC) [17]

(3) (acoustically tunable optical filter) The ratio of the dynamic transmission at a given acoustic frequency and power level to the dynamic transmission with no applied acoustic power. Note: The contrast ratio is a measure of light leakage through the device. It should be specified for either a monochromatic or white light source input, and the angular spread of the input light. (UFC) [17]

contrast rendition factor (illuminating engineering) The ratio of visual task contrast with a given lighting environment to the contrast with sphere illumination. (EEC/IE) [126]

contrast sensitivity (illuminating engineering) The ability to detect the presence of luminance differences. Quantitatively, it is equal to the reciprocal of the brightness contrast threshold. See also: brightness contrast threshold. (EEC/IE) [126]

contrast stretching An image enhancement technique in which the contrast between image subsets and their complements is increased. (C) 610.4-1990

contrast transfer function square-wave response (diode-type camera tube) The contrast transfer function or CTF represents the response of the imaging system in the spatial frequency domain to a square-wave input. A bar pattern represents a one-dimensional input to a two-dimensional imaging sensor. CTF is synonymous with the square-wave amplitude response, $R_{sq}(N)$. (ED) 503-1978w

contributing cause A cause that, of itself, may not result in failure. (PE/SWG) C37.10-1995

control (1) (A) (electronic computation) Usually, those parts of a digital computer that effect the carrying out of instructions in proper sequence, the interpretation of each instruction, and the application of the proper signals to the arithmetic unit and other parts in accordance with this interpretation. (B) (electronic computation) In some business applications of mathematics, a mathematical check. (C) 162-1963w

(2) (cryotron) An input element of a cryotron. (ED) [46]

(3) (packaging machinery) A device or group of devices that serves to govern in some predetermined manner the electric power delivered to the apparatus to which it is connected. (IA) 333-1980w

(4) (electric power systems in commercial buildings) Any device used for regulation of a system or component. (IA) 241-1990

(5) (overhead power lines) In experiments, establishment of an untreated group of animals, plants, cells, etc., that serve as the basis for comparing responses of a similar, but treated, group that has been subjected (exposed) to some agent (i.e., an electric field). (PE/T&D) 539-1990

(6) A visual user interface element that is defined by IEEE Std 1295-1993. (C) 1295-1993

(7) The execution of a system change by manual means, remote means, automatic means, or partially automatic means. (PE/SWG/SUB) C37.1-1987s, C37.100-1992

control accuracy The degree of correspondence between the final value and the ideal value of the directly controlled variable. See also: control system, feedback. (IA) [60]

control action The total effective control action for which the input is the input signal or the control action with which the input is the input signal.

(2) The total effective control action for which the input is the input signal.

(2) (automatic controller) is input.

control action is proportional control system (2) Control : time integral is proportion of integral output, neglecting

$$\frac{Y}{X} = \pm \frac{I/s}{bI + s}$$

where
b = recip
1/2π = gain
s = complex
X = input
Y = output

(3) A control put proportion

control action, is a continuous input. Note: input are with (2) (automatic) relation between The ratio of the control action proportional gain control action, which the output the input and practical effect action the high frequency

$$\frac{Y}{X} = \pm P \frac{s}{bI + s}$$

where
a = derivative
D = derivative
P = proportion
s = complex
X = input
Y = output
t
Synonym: P.I

control action

control action (automatic control) Of a control element or a controlling system, the nature of change of the output effected by the input. *Note:* The output may be a signal or the value of a manipulated variable. The input may be the control loop feedback signal when the command is constant, an actuating signal, or the output of another control element. One use of control action is to effect compensation. *See also:* compensation. (PE) [3]

control acquisition (1) The total of all bus activity associated with acquiring exclusive control of the bus by a module. (BA/C) 896.3-1993

(2) The total of all bus activity associated with acquiring exclusive control of the bus. (BA/C) 10857-1994, 896.4-1993

control action, derivative (1) The component of control action for which the output is proportional to the rate of change to the input. *See also:* control system, feedback. (IA/PE) [60], 94-1970w

(2) (automatic control) Action in which the output of the controller is proportional to the first time derivative of the input. (PE) 94-1970w

control action, integral (1) Control action in which the output is proportional to the time integral of the input. *See also:* control system, feedback. (IA/PE) [60], 94-1970w

(2) Control action in which the output is proportional to the time integral of the input, that is the rate of change of output is proportional to the input. *Note:* In the practical embodiment of integral control action the relation between output and input, neglecting high frequency terms, is given by

$$\frac{Y}{X} = \pm \frac{I/s}{bl/s + 1} \quad 0 \leq b \ll 1$$

where

b = reciprocal of static gain

$I/2\pi$ = gain cross-over frequency in cycles per unit time

s = complex variable

X = input transform

Y = output transform

(CS/PE) [3]

(3) A control mode is designated to provide a controlled output proportional to the time integral of the input. (PE) 94-1991

control action, proportional (1) Control action in which there is a continuous linear relation between the output and the input. *Note:* This condition applies when both the output and input are within their normal operating ranges. (IA) [60]

(2) (automatic control) Action in which there is a linear relation between the output and the input of the controller. *Note:* The ratio of the change in output produced by the proportional control action to the change in input is defined as the proportional gain. (PE) 94-1970w

control action, proportional plus derivative Control action in which the output is proportional to a linear combination of the input and the time rate-of-change of input. *Note:* In the practical embodiment of proportional plus derivative control action the relationship between output and input, neglecting high frequency terms, is

$$\frac{Y}{X} = \pm P \frac{\frac{I}{s} + 1 + Ds}{bl/s + 1 + \frac{Ds}{a}} \quad \begin{matrix} a > 1 \\ 0 \leq b \ll 1 \end{matrix}$$

where

a = derivative action gain

D = derivative action time constant

P = proportional gain

s = complex variable

X = input transform

Y = output transform

Synonym: P.D.

(CS/PE) [3]

control action, proportional plus integral Control action in which the output is proportional to a linear combination of the input and the time integral of the input. *Note:* In the practical embodiment of proportional plus integral action the relation between output and input, neglecting high frequency terms, is

$$\frac{Y}{X} = \pm P \frac{\frac{I}{s} + 1}{bl/s + 1} \quad 0 \leq b \ll 1$$

where

b = proportional gain/static gain

I = integral action rate

P = proportional gain

s = complex variable

X = input transform

Y = output transform

(CS/PE) [3]

Synonym: P.I.

control action, proportional plus integral plus derivative Control action in which the output is proportional to a linear combination of the input, the time integral of input and the time rate-of-change of input. *Note:* In the practical embodiment of proportional plus integral plus derivative control action the relationship of output and input, neglecting high frequency terms, is

$$\frac{Y}{X} = \pm P \frac{1 + sD}{1 + sD/a} \quad a > 1$$

where

a = derivative action gain

b = proportional gain/static gain

D = derivative action time constant

I = integral action rate

P = proportional gain

s = complex variable

X = input transform

Y = output transform

Synonym: P.I.D.

(CS/PE) [3]

control and instrumentation cables (cable systems in substations) Insulated electrical conductors utilized to convey information or to intermittently operate devices controlling power switching or conversion equipment. The cross-sectional areas of the conductors are generally No. 6 American Wire Gage (AWG) or smaller, and the duty cycle is such that conductor heating is insignificant. 382

control and status register (CSR) (1) A memory-mapped register that is accessed through read and write transactions and is used to observe the state of a node or to control its operation. (BA/C) 896.9-1994

(2) A register used to control the operation of a device and/or record the status of an operation. It is accessible through a separate address space in a FASTBUS device. CSR#0, mandatory for all devices, contains the manufacturer's ID for the device and a number of device status bits as well as some user-defined bits. 960-1993

(3) A register, storage location, or address that is used to control buses, interconnects, and multiple processor systems. (BA/C) 14536-1995

control and status registers (CSR) A set of registers, storage locations, and addresses that are used to control buses, interconnects, and multiple processor systems. (BA/C) 896.5-1993s

control and status register space (FASTBUS acquisition and control) A FASTBUS primary address cycle may specify with a code on the mode select (MS) control lines one of two separate address spaces in a device; CSR space and data space. CSR space contains registers for control of and status reporting registers for the device. Its allocation and usage is part of the FASTBUS specification. *Synonym:* CSR space. 960-1986s

See also: data space.

control apparatus

control apparatus A set of control devices used to accomplish the intended control functions. *See also:* control.

control area (1) (electric power) A power system, a part of a power system, or a combination of several power systems under common control for which a single area control error is defined. (IA) [60] (PE) 94-1991

(2) A storage area used to hold information necessary for the control of a task, function, or operation. (C) 610.10-1994

(3) A power system, a part of a power system, or a combination of several power systems under common control, that uses tie-line bias control if it is part of an interconnected system. (PE) 858-1993

control ball An input device consisting of a ball, rotatable about its center and recessed into a surface, used as a locator. *Synonym:* track ball. (C) 610.6-1991

control battery A battery used as a source of energy for the control of an electrically operated device. (IA) [60]

control block (1) (subroutines for CAMAC) The symbol *cb* represents an integer array having four elements. The contents of these elements are:

element 1	Repeat Count
element 2	Tally
element 3	LAM Identification
element 4	Channel Identification

The repeat count specifies the number of individual CAMAC actions or the maximum number of data words to be transferred. Some multiple action and block transfer subroutines permit termination of the sequence upon a signal from the addressed module. In such cases the repeat count represents an upper limit. The tally is the number of actions usually performed or the number of CAMAC data words actually transferred. If the block transfer or multiple action is terminated by the controller due to exhaustion of the repeat count, the tally will be equal to the repeat count; otherwise it may be less. The LAM identification is an integer value having the same form and information content as the variable *lam*. The channel identification is an integer value which identifies system-dependent facilities which may be necessary to perform the block transfer or multiple action. This number, if it is required, has the same form and content as the parameter *chan* and can be created by the subroutine CDCHN. (NPS) 758-1979r.

(3) The circuitry within a computer that performs control functions such as decoding microinstructions and generating the internal control signals that perform requested operations. (C) 610.10-1994

control board (control boards, panels, and racks) An assembly of panels on which are installed components and modules for monitoring, measuring, and controlling remotely operated systems and equipment. It provides a visual and physical interface between the operator and the systems. *Synonyms:* benchboard; console; control panel; control switchboard. (PE) 420-1982

control breakpoint *See:* code breakpoint.

control bus (1) A bus that carries signals that regulate system operations. (C) 610.10-1994

(2) A bus used to distribute power for operating electrically controlled devices. (PE/SWG) C37.100-1992

control cable (1) (cable systems in power generating stations) Cable applied at relatively low current levels or used for intermittent operation to change the operating status of a utilization device of the plant auxiliary system. (PE) 422-1977

(2) **(communication and control cables)** A cable that usually carries relatively low current levels used for indication purposes to change the operating status of a utilization device of a plant auxiliary system. A control cable usually consists of two or more insulated, unpaired, shielded or unshielded conductors. Sizes may be No 22, 20, 19, 18, or 16 AWG solid and No 14, 12, 10, or 9 AWG stranded or solid conductor.

control conductor

Control cable conductor insulation usually has voltage ratings of 300, 600, or 1000 V rms, 50-60 Hz. (PE) 789-1991

(3) Cable used in a control function application, e.g., in connection of control switches, indicating lights, relays, solenoids, etc. Generally the cable construction is 600 V, 1000 V, single or multiple conductors, typically in wire sizes 14 AWG (2.08 mm²), 12 AWG (3.31 mm²), 10 AWG (5.26 mm²), 9 AWG (6.63 mm²), or 8 AWG (8.37 mm²). (PE) 1185-1991

control card A punch card containing input parameters for controlling the execution of a program or job. (C) 610.10-1994

control center (1) (generating stations electric power system) An assembly of devices for the purpose of switching and protecting a number of load circuits. The control center may contain transformers, contactors, circuit breakers, protective and other devices intended primarily for energizing and de-energizing load circuits. (PE) 505-1977r

(2) The facility from which instructions and signals are issued for controlling the bulk electric system, and, in some instances, the distribution system as well. (PE) 858-1993

control character (1) A character whose occurrence in a particular context initiates, modifies, or stops a control operation, for example, a character to control carriage return. (C) [20], [85]

(2) (A) **(data management)** A character whose occurrence in a particular context initiates, modifies, or stops a control operation. A control character may be recorded for use in a subsequent action, and it may have a graphic representation in some circumstances. *Synonyms:* command character; functional character; operational character. *See also:* accuracy control character; device control character; print control character; transmission control character. (B) **(data management)** A character that initiates some kind of physical control action but is not printed on the output page. For example, line feed, tab, form feed. (C) 610.5-1990

(3) A character used for signaling purposes by the exchange, packet or transaction layers of the stack. Both Nchars and Lchars are used as control characters. *See also:* link character; normal character. (BA/C) 1355-1995

control characteristic (gas tube) A relation, usually shown by a graph, between critical grid voltage and anode voltage. *See also:* gas tube. (ED) 161-1971w

control circuit (1) (electric installations on shipboard) The circuit which carries the electric signals of a control apparatus or system directing the performance of the controller but which does not carry the main power circuit. (IA) 45-1983r

(2) **(packaging machinery)** The circuit that carries the electric signals directing the performance of the controller but does not carry the main power circuit. (IA) 333-1980w

control circuit failure Failure attributed to the inability of the electrical control circuit to perform its function. (PE/SWG) C37.10-1995

control-circuit limit switch A limit switch the contacts of which are connected only into the control circuit. *See also:* control; switch. (IA) [60]

control circuit transformer (packaging machinery) A voltage transformer utilized to supply a voltage suitable for the operation of control devices. (IA) 333-1980w

control circuit voltage (packaging machinery) The voltage provided for the operation of shunt coil magnetic devices. (IA) 333-1980w

control compartment (packaging machinery) A space within the base, frame, or column of the machine, used for mounting the control panel. (IA) 333-1980w

control conductor (substation grounding) The conductor that is utilized to measure equivalent changes in temperature, size, etc., that are occurring in at least one of the conductors joined by the connector under test. (PE/SUB) 837-1989r

control coupling

control coupling A type of coupling module communicates information to an explicit purpose of influencing the la. *Contrast:* common-environment coupling; data coupling; hybrid coupling; path coupling.

control current (Hall effect devices) Hall plate that by its interaction with generates the Hall voltage.

control current sensitivity (Hall effect) The voltage across the Hall terminals a given magnitude of magnetic flux.

control current terminals (Hall effect) through which the control current flows.

control cut-out switch (land transport) lating switch that isolates the control troller from the source of energy.

control data (software) Data that select the sequential flow of a program influence the operation of software; f trol variable.

control designation symbol A symbol ticular manner, permissible or required variable (possibly in combination with the logic element to perform according

control desk (console) A control switch or more relatively short horizontal or i on an assembly of such a height that vices are within convenient reach of (PE/SWG) C37.10

control device An individual device used function. *See also:* control.

control dial An input device, consisting knobs or levers, that provides coordin

control directory The directory below for filesets and products are stored wi for distributions and installed software

control electrode (electron tube) An electrode or vary the current between two or mo electrode.

control-electrode discharge recovery ti The time required for the control-e deionize to a level such that a specified high-power level is required to ionize tube.

control enclosure (packaging machinery) for the control panel, whether moun equipment or separately mounted.

control exciter (rotating machinery) A rotary amplifier in a closed-loop circui nous machine.

control field (1) The sequence of eight (0 bits immediately following the address octet identifies the HDLC frame type. (E

(2) A sequence of bits that identifies th transmitted, and optionally, contains s edgment numbers.

(3) The field immediately following t address fields of a PDU. The content interpreted by the receiving destination the DSAP address field:

1) As a command, from the source LI SSAP address field, instructing the specific function; or

control coupling

control coupling A type of coupling in which one software module communicates information to another module for the explicit purpose of influencing the latter module's execution. *Contrast*: common-environment coupling; content coupling; data coupling; hybrid coupling; pathological coupling. (C) 610.12-1990

control current (Hall effect devices) The current through the Hall plate that by its interaction with a magnetic flux density generates the Hall voltage. (MAG) 296-1969w

control current sensitivity (Hall effect devices) The ratio of the voltage across the Hall terminals to the control current for a given magnitude of magnetic flux density. (MAG) 296-1969w

control current terminals (Hall effect devices) The terminals through which the control current flows. (MAG) 296-1969w

control cut-out switch (land transportation vehicles) An isolating switch that isolates the control circuits of a motor controller from the source of energy. (VT) 16-1955w

control data (software) Data that select an operating mode, direct the sequential flow of a program, or otherwise directly influence the operation of software; for example, a loop control variable. (C) 610.12-1990

control designation symbol A symbol that identifies the particular manner, permissible or required, in which an input variable (possibly in combination with other variables) causes the logic element to perform according to its defined function. (GSD) 91-1973s

control desk (console) A control switchboard consisting of one or more relatively short horizontal or inclined panels mounted on an assembly of such a height that the panel-mounted devices are within convenient reach of an attendant. (PE/SWG) C37.100-1992, C37.21-1985r

control device An individual device used to execute a control function. *See also*: control. (IA) [60]

control dial An input device, consisting of one or more rotating knobs or levers, that provides coordinate input data. (C) 610.6-1991

control directory The directory below which the control files for filesets and products are stored within exported catalogs for distributions and installed software. (C/PA) 1387.2-1995

control electrode (electron tube) An electrode used to initiate or vary the current between two or more electrodes. *See also*: electrode. (ED) 161-1971w

control-electrode discharge recovery time (attenuator tubes) The time required for the control-electrode discharge to deionize to a level such that a specified fraction of the critical high-power level is required to ionize the tube. *See also*: gas tube. (ED) 161-1971w

control enclosure (packaging machinery) The metal housing for the control panel, whether mounted on the industrial equipment or separately mounted. (IA) 333-1980w

control exciter (rotating machinery) An exciter that acts as a rotary amplifier in a closed-loop circuit. *See also*: asynchronous machine. (PE) [9]

control field (1) The sequence of eight (or sixteen, if extended) bits immediately following the address field of a frame. This octet identifies the HDLC frame type. (EMB) 1073.3.1-1994

(2) A sequence of bits that identifies the type of frame being transmitted, and optionally, contains sequence or acknowledgment numbers. (C) 610.7-1995

(3) The field immediately following the DSAP and SSAP address fields of a PDU. The content of the control field is interpreted by the receiving destination LLC(s) designated by the DSAP address field:

1) As a command, from the source LLC designated by the SSAP address field, instructing the performance of some specific function; or

2) As a response, from the source LLC designated by the SSAP address field.

(C/LM/PE) 799-1987r, 8802-2-1994

control files The control scripts executed by the utilities, the INFO file describing the files in a fileset, and other files associated with a software object. (C/PA) 1387.2-1995

control flow The sequence in which operations are performed during the execution of a computer program. *Synonym*: flow of control. *Contrast*: data flow. (C) 610.12-1990

control flow architecture A computer architecture in which execution is controlled by the need for a particular result; that is, an instruction is executed only when its result is needed by another process. *Synonym*: Von Neumann architecture. *Contrast*: data flow architecture; Harvard class architecture. (C) 610.10-1994

control flow diagram A diagram that depicts the set of all possible sequences in which operations may be performed during the execution of a system or program. Types include box diagram, flowchart, input-process-output chart, state diagram. *Contrast*: data flow diagram. *See also*: call graph; structure chart. (C) 610.12-1990

control flow trace *See*: execution trace.

control function *See*: supervisory control functions.

control function check Control and indication from a control-check relay. A check of master and remote station equipment by exercising a predefined component or capability. (PE/SUB) C37.1-1994

control generator A generator, commonly used on electric motive power units for the generation of electric energy in proportion to vehicle speed, prime mover speed, or some similar function, thereby serving as a guide for initiating appropriate control functions. *See also*: traction motor. (EEC/PE) [119]

control grid (electron tube) A grid, ordinarily placed between the cathode and an anode, for use as a control electrode. *See also*: electrode; grid. (ED) 161-1971w

control hole *See*: designation hole.

control initiation The function introduced into a measurement sequence for the purpose of regulating any subsequent control operations in relation to the quantity measured. *Note*: The system element comprising the control initiator is usually included in the end device but may be associated with the primary detector or the intermediate means. *See also*: measurement system. (EEC/PE) [119]

control interaction factors In a proportional plus integral plus derivative control action unit, the ratio of the effective values to the values that would be measured when the product (integral action rate) (derivative action time constant) is zero. Example: Assume a control unit composed of elements whose ratios of output to input are $1 + D's$ and $P'(I'/s + 1)$ connected so that the output of one is the input of the other. The ratio of output to input of the combination is

$$\frac{Y}{X} = P'(1 + I'D') \left[\frac{I'/s}{1 + I'D'} + 1 + \frac{D's}{1 + I'D'} \right]$$

By comparison with the equation

$$\frac{Y}{X} = P \left[\frac{1}{s} + 1 + Ds \right]$$

it is seen that the effective values are

$$P = P'(1 + I'D') = \text{proportional gain}$$

$$I = I'/(1 + I'D') = \text{integral action rate}$$

$$D = D'/(1 + I'D') = \text{derivative action time constant.}$$

When either I' or D' is set equal to zero the factor $1 + I'D'$ equals unity and the measured values are P' , I' and D' . Consequently, $1 + I'D'$ is the "proportional interaction factor" and $1/(1 + I'D')$ is both the "integral action rate interaction factor" and "derivative action time interaction factor."

(CS/PE) [3]

control key

control key (CTRL) Any key on a keyboard that is used to control a process. *Note:* The control character, usually labelled "CTRL" is said to represent a control character, and when used in conjunction with another key, such as "C", the combination is said to represent the control character "CONTROL C" or "C". *Contrast:* typing key. *See also:* alternate key; attention key; command key; cursor control key; enter key; escape key; function key; shift key. (C) 610.10-1994

controllability In comparison of processes, a qualitative term indicating the relative ease with which they can be controlled. *Note:* The type of disturbance for which the comparison is made should be specified. (CS/PE) [3]

controllable A property of a component of a state whereby, given an initial value of the component at a given time, there exists a control input that can change this value to any other value at a later time. *See also:* control system. (IM) [120]

controllable, completely The property of a plant whereby all components of the state are controllable within a given time interval. *See also:* control system. (IM) [120]

control language *See:* job control language.

control law A function of the state of a plant and possibly of time, generated by a controller to be applied as the control input to a plant. *See also:* control system. (IM) [120]

control law, closed-loop A control law specified in terms of some function of the observed state. *See also:* control system. (IM) [120]

control law, open-loop A control law specified in terms of the initial state only and possibly of time. *See also:* control system. (IM) [120]

controlled access (communication satellite) A mode of operation of a communication satellite in which an earth station desiring access to the system must request and obtain access to the system via a network management facility. (COM) [19]

controlled area (laser maser) An area where the occupancy and activity of those within is subject to control and supervision for the purpose of protection from radiation hazards. (LEO) 586-1980w

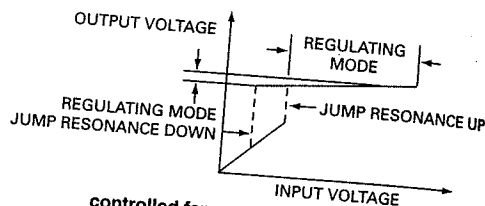
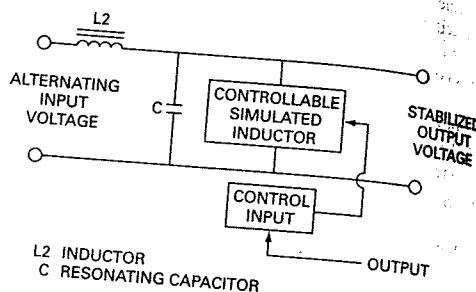
controlled-avalanche rectifier diode (semiconductor) A rectifier diode that has specified maximum and minimum breakdown-voltage parameters and is specified to operate under steady-state conditions in the breakdown region of its reverse characteristic. *See also:* breakdown. (IA) [12]

controlled carrier (floating carrier) (variable carrier) A system of compound modulation wherein the carrier is amplitude modulated by the signal frequencies in any conventional manner, and, in addition, the carrier is simultaneously amplitude modulated in accordance with the envelope of the signal so that the percentage of modulation, or modulation factor, remains approximately constant regardless of the amplitude of the signal. (AP/BT) 145-1983s, 182A-1964w

controlled ESD environment One in which an attempt is made to maintain charge levels on humans and objects below a certain level. Typical control measures include humidity controls, equipment earth grounding, use of antistatic materials, ionized air, and high-resistance discharge paths for humans. (EMC) C63.16-1993

controlled ferroresonant regulators (ferroresonant voltage regulators) A regulator consisting basically of an inductor connected in series with a parallel combination of a capacitor and controllable simulated inductor. This combination is connected across the source as shown in the figure below. Stabilized output voltage is derived by inductive or conductive coupling to the parallel combination of C and the controllable simulated inductor. In a controlled ferroresonant regulator the controllable simulated inductor can be a combination of switching devices (such as thyristors or transistors) and linear or saturating inductors. This circuit, in combination with a control input to the simulated inductor, controls the flux swing (or simulated flux swing) in the saturated (or simulated sat-

urating) inductor, thereby controlling the stabilized output voltage.



controlled ferroresonant regulators (PEL) 449-1990

controlled list (A) A list whose access is controlled in some way; for example, access to an array is controlled by its index variable. (B) A list that can contain a finite number of entries. (C) 610.5-1990

controlled list data element A data element that is contained in a controlled list. (C) 610.5-1990

controlled manual block signal system A series of consecutive blocks governed by block signals, controlled by continuous track circuits, operated manually upon information by telegraph, telephone, or other means of communication, and so constructed as to require the cooperation of the signalmen at both ends of the block to display a clear or permissive block signal. *See also:* block-signal system. (EEC/PE) [119]

controlled overvoltage test (rotating machinery) (dc leakage, measured current, or step voltage test) A test in which the increase of applied direct voltage is controlled and measured currents are continuously observed for abnormalities with the intention of stopping the test before breakdown occurs. (PE) 95-1977r

controlled plasma switch (nonlinear, active, and nonreciprocal waveguide components) A triggered gas switch that uses an electron-beam-excited gaseous plasma in a waveguide to limit or switch radio frequency (rf) power. (MTT) 457-1982w

controlled rectifier A rectifier in which means for controlling the current flow through the rectifying devices is provided. *See also:* electronic controller; rectification. (EEC/PE) [119]

controlled slip *See:* slip, controlled.

controlled-speed axle generator An axle generator in which the speed of the generator is maintained approximately constant at all vehicle speeds above a predetermined minimum. *See also:* axle-generator system. (EEC/PE) [119]

controlled system (automatic control) The apparatus, equipment, or machine used to effect changes in the value of the ultimately controlled variable. *See also:* control system. (PE) [3]

controlled vented power fuse (installations and equipment operating at over 600 volts, nominal) A fuse with provision for controlling discharge circuit interruption such that no solid material may be exhausted into the surrounding atmosphere. The discharge gases shall not unite or damage insulation in the path of the discharge nor shall these gases propagate a flashover to or between grounded members or conduction members in the path of the discharge when the distance between the vent and such insulation or conduction members

controller conforms to manufacturer's recommendations

controller (1) (electric pipe heat) regulates the state of a system with a sensor located in the system with adjusting its output to achieve the desired temperatures on the system and can be controlled by controllers or thermostats. Control devices include (bulb, bimetallic) or electrical temperature detector [RTD] thermostat. (PE)

(2) A device or group of devices that controls some predetermined manner, the apparatus to which it is connected.

(3) (packaging machinery) A device that serves to control in some predetermined manner to which it is connected.

(4) The component of a system that controls a controller. A controller typically receives response messages

(5) (A) A functional unit in a computer system that controls one or more units of the peripheral control unit. *See also:* data output controller. (B) In robotic input desired and measured position variables and whose output controls the motor or activator. (C) / can introduce commands to a controller.

(6) The entity that initiates a command exactly one controller on each R:

(7) (CAMAC system) *See also:* SBus Controller.

(8) *See also:* SBus Controller.

Controller *See:* SBus Controller.

controller, automatic (process control) automatically to regulate a controlled process a command and a feedback signal in process control usage. Feedback elements may also be part of the system, feedback.

controller characteristics (thyristor) characteristics of an ac power controller input or output terminal.

controller current (thyristor) The current through the terminals of the controller.

controller diagram (electric power) shows the electric connections between the controller and that shows the

controller equipment (thyristor) power control comprising one or more power control devices together with any input or output switching devices and auxiliary power controller to function.

controller faults (thyristor) A fault condition of some semiconductor device.

controller ON-state interval (thyristor) which the controller conducts. *N* starting instant of the controller (or the starting instant of the

controller power transformer (within the controller employed in the transformation of voltage or current).

controller section (thyristor) That part of the controller containing the basic control elements and the load voltage.

conforms to manufacturer's recommendations.

(NEC/NESC) [86]

controller (1) (electric pipe heating systems) A device that regulates the state of a system by comparing a signal from a sensor located in the system with a predetermined value and adjusting its output to achieve the predetermined value. Controllers, as used in electric pipe heating systems, regulate temperatures on the system and can be referred to as temperature controllers or thermostats. Controller sensors can be mechanical (bulb, bimetallic) or electrical (thermocouple, resistance-temperature detector [RTD] thermistor).

(PE) 622A-1984r, 622B-1988r

(2) A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected. (NEC/NESC) [86]

(3) (packaging machinery) A device or group of devices that serves to control in some predetermined manner the apparatus to which it is connected. (IA) 333-1980w

(4) The component of a system that functions as the system controller. A controller typically sends program messages to and receives response messages from devices.

(IM) 488.2-1992

(5) (A) A functional unit in a computer system that controls one or more units of the peripheral equipment. *Synonym:* peripheral control unit. *See also:* dual-channel controller; input-output controller. (B) In robotics, a processor that takes as input desired and measured position, velocity or other pertinent variables and whose output is a drive signal to a controlling motor or activator. (C) A device through which one can introduce commands to a control system.

(C) 610.10-1994

(6) The entity that initiates RamLink transactions. There is exactly one controller on each RamLink ringlet.

(C/MM) 1596.4-1996

(7) (CAMAC system) *See also:* CAMAC crate.

(8) *See also:* SBus Controller. (BA/C) 1496-1993

Controller *See:* SBus Controller.

controller, automatic (process control) A device that operates automatically to regulate a controlled variable in response to a command and a feedback signal. *Note:* The term originated in process control usage. Feedback elements and final control elements may also be part of the device. *See also:* control system, feedback. (PE) [3]

controller characteristics (thyristor) The electrical characteristics of an ac power controller measured or observed at its input or output terminal. (IA) 428-1981w

controller current (thyristor) The current flowing through the terminals of the controller. (IA) 428-1981w

controller diagram (electric-power devices) A diagram that shows the electric connections between the parts comprising the controller and that shows the external connections.

(IA) [60], 270-1966w

controller equipment (thyristor) An operative unit for ac power control comprising one or more thyristor assemblies together with any input or output transformers, filters, other switching devices and auxiliaries required by the thyristor ac power controller to function. (IA) 428-1981w

controller faults (thyristor) A fault condition exists if the conduction cycles of some semiconductors are abnormal.

(IA) 428-1981w

controller ON-state interval (thyristor) The time interval in which the controller conducts. *Note:* It is assumed that the starting instant of the controller ON-state interval is coincident with the starting instant of the trigger pulse.

(IA) 428-1981w

controller power transformer (thyristor) A transformer within the controller employed to provide isolation or the transformation of voltage or current, or both.

(IA) 428-1981w

controller section (thyristor) That part of a controller circuit containing the basic control elements necessary for controlling the load voltage. (IA) 428-1981w

controller, self-operated (automatic control) A control device in which all the energy to operate the final controlling element is derived from the controlled system through the primary detecting element. (PE) [3]

controllers for steel-mill accessory machines Controllers for machines that are not used directly in the processing of steel, such as pumps, machine tools, etc. *See also:* electric controller. (IA) [60]

controllers for steel-mill auxiliaries Controllers for machines that are used directly in the processing of steel, such as screw-downs and manipulators but not cranes and main rolling drives. *See also:* electric controller. (IA) [60]

controller, time schedule (process control) A controller in which the command (or reference input signal) automatically adheres to a pre-determined time schedule. *Note:* The time schedule mechanism may be programmed to switch motors or other devices. (PE) [3]

controlling element, final That forward controlling element which directly changes the value of the manipulated variable. (CS/PE) [3]

controlling elements The functional components of a controlling system. *See also:* control system, feedback.

(IM/PE) [120], [3]

controlling elements, forward The elements in the controlling system that change a variable in response to the actuating signal. *See also:* control system, feedback.

(IM/PE) [120], [3]

controlling means (of an automatic control system) Consists of those elements that are involved in producing a corrective action. (PE) 94-1970w

controlling section A length of track consisting of one or more track circuit sections, by means of which the roadway elements or the device that governs approach to or movement within a block are controlled. (EEC/PE) [119]

controlling system (1) (automatic control system without feedback) That portion of the control system that manipulates the controlled system. (IM/PE) [120], [3]

(2) (control system feedback) The portion that compares functions of a directly controlled variable and a command and adjusts a manipulated variable as a function of the difference. *Note:* It includes the reference input elements; summing point; forward and final controlling elements; and feedback elements. *See also:* control system, feedback.

(IM/PE) [120], [3]

controlling voltage, composite *See:* composite controlling voltage.

control machine (A) (railroad practice) An assemblage of manually operated levers or other devices for the control of signals, switches, or other units, without mechanical interlocking, usually including a track diagram with indication lights. *See also:* car retarder. (B) (railroad practice) A group of levers or equivalent devices used to operate the various mechanisms and signals that constitute the car retarder installation. *See also:* car retarder; centralized traffic-control system. (EEC/PE) [119]

control, manual Those elements in the excitation control system which provide for manual adjustment of the synchronous machine terminal voltage by open-loop control.

(PE) 421-1972s

control mechanism (control systems for steam turbine-generator units) Includes all systems, devices, and mechanisms between a controller and the controlled valves.

(PE) 122-1985s

control metering point (1) (tie line) The location of the metering equipment that is used to measure power on the tie line for the purpose of control. *See also:* center of distribution; power system. (PE) [54]

(2) (electric power system) The actual or equivalent location of power flow measurement on an area tie line.

(PE) 94-1991

control mode (thyristor) The starting instant of the controller ON-state interval is periodic. The control mode is defined

control operator

only for steady state operation. *Note:* It is possible to combine several control modes, for example, ON-OFF control and phase control. *See also:* operation modes.

control operator In the shell command language, a token that performs a control function. A control operator is one of the following symbols:

```
&
&&
(
)
;
;;
(newline)
|
```

The end-of-input indicator used internally by the shell is also considered a control operator. On some systems, the symbol ((is a control operator; its use produces unspecified results.

control panel (1) (station control and data acquisition) (supervisory control, data acquisition, and automatic control) An assembly of man/machine interface devices.

(2) The part of a console that contains switches, pushbuttons and indicators.

control point (project control point) A project agreed on point in time or times when specified agreements or controls are applied to the software configuration items being developed; e.g., an approved baseline or release of a specified document/code.

control point interfaces Master station or RTU (or both) element(s) that operate(s) to perform a control function.

control point selector (test, measurement, and diagnostic equipment) A device capable of selecting and controlling the proper stimuli, power of loads, and applying it to the unit under test, in accordance with instructions from the programming device.

control position electric indicator A device that provides an indication of the movement and position of the various control surfaces or structural parts of an aircraft. It may be used for wing flaps, cowl flaps, trim tabs, oil-cooler shutters, landing gears, etc.

control positioning accuracy, precision, or reproducibility (numerically controlled machines) Accuracy, precision, or reproducibility of position sensor or transducer and interpreting system and including the machine positioning servo. *Note:* May be the same as machine positioning accuracy, precision, or reproducibility in some systems.

control power disconnecting device (power system device function numbers) A disconnecting device, such as a knife switch, circuit breaker, or pull-out fuse block, used for the purpose of respectively connecting and disconnecting the source of control power to and from the control bus or equipment. *Note:* Control power is considered to include auxiliary power which supplies such apparatus as small motors and heaters.

control-power winding (power and distribution transformers) The winding (or transformer) which supplies power to motors, relays, and other devices used for control purposes. *Synonym:* control-power transformer.

control-power transformer *See:* control-power winding.

control precision Precision evidenced by either the directly or the indirectly controlled variable, as specified.

control procedure The means used to control the orderly communication of information between stations on a data link.

controlling process The session leader that established the connection to the controlling terminal. Should the terminal sub-

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sequently cease to be a controlling terminal for this session the session leader shall cease to be the controlling process.

controlling terminal A terminal that is associated with a session. Each session may have at most one controlling terminal associated with it, and a controlling terminal is associated with exactly one session. Certain input sequences from the controlling terminal cause signals to be sent to all processes in the process group associated with the controlling terminal.

control program *See:* supervisory program.

control punch *See:* designation hole.

control ratio (1) (gas tube) The ratio of the change in anode voltage to the corresponding change in grid voltage, with all other operating conditions maintained constant. *See also:* gas tube.

(2) (power supplies) The required charge in control resistance to produce a one-volt change in the output voltage. The control ratio is expressed in ohms per volt and is reciprocal of the bridge current.

control read-only memory (CROM) A type of read-only storage in the control block of some processors such that the ROM has been programmed to decode the control logic.

control register A register in a computer or peripheral device, the contents of which control the operations of the computer or peripheral. *See also:* device register; program counter.

control relay An auxiliary relay whose function is to initiate or permit the next desired operation in a control sequence.

control room complex (nuclear power generating station) The complex that houses and protects plant operating personnel and control and instrumentation equipment. It includes the central control room, adjacent rooms that house supporting control equipment and instrumentation (sometimes known as the auxiliary equipment room), ventilation and life support equipment, and the cable spreading areas serving the equipment therein.

control SCADA function The capability of a supervisory system to selectively perform manual or automatic, or both, operation (singularly or in selected groups) of external devices. Control may be either analog (magnitude or duration) or digital.

control script A control file associated with a software object that is executed by the software administration utilities.

control sequence table (electric-power devices) A tabulation of the connections that are made for each successive position of the controller.

control signal Any signal that purposely affects the recording, processing, transmission or interpretation of data by a system element.

control signal one An encoded control signal used on the control in and control out circuits. A CS1 is encoded as a signal at half the bit rate (BR/2).

control signal zero An encoded control signal used on the control in and control out circuits. A CS0 is encoded as a signal at the bit rate (BR). *(C/LM)* 802.3u-1995, 8802-3-1990s

control span *See:* sag span.

control statement (software) A program statement that selects among alternative sets of program statements or affects the order in which operations are performed. For example, if-then-else, case. *Contrast:* assignment statement; declaration.

control station (1) (mobile communication) A base station, the transmission of which is used to control automatically the emission or operation of another radio station. *See also:* mobile communication system.

control store**control store**

(2) A facility that provides a means for controlling the simulation of a system.

control store (software) computer memory in a microword, nanostore.

control structure (software) flow of control through a program; conditions.

control switch A manual or automatic power-operated switch, interlocking, etc.,

control switchboard A terminal or instrumentation, meter equipment for remotely switching devices or the control of a process.

control-switching point switching entity arrangement dialing network, etc.

control system (1) (broadband) A system coordinated to execute a control.

(2) A system in which the control is a measure of the acceptable range of value of a variable; network transfer function.

(3) (automatic control) A system in which the control is a variable. *Note:* It is a controlled system.

(4) A system in which the control is a variable; the desired effect, falls with the desired effect, falls with the desired effect, falls with the desired effect.

control system, adaptive A system in which the control means are used in a way intended to improve the control system.

control system, automatic A system in which the control means are used in a way intended to improve the control system.

control system, automatic A system that operates without human intervention.

control system, cascade A system in which the control means are used in a way intended to improve the control system.

control system, closed-loop A system in which the control means are used in a way intended to improve the control system.

control system, coarse-fine A system in which the control means are used in a way intended to improve the control system.

control system, dual-mode A system in which the control means are used in a way intended to improve the control system.

control store

(2) A facility that provides the individual responsible for controlling the simulation and that provided the capability to implement simulation control as PDUs on the DIS network. (C/DIS) 1278.3-1996

control store (software) In a microprogrammed computer, the computer memory in which microprograms reside. *See also:* microword; nanostore. (C) 610.10-1994, 610.12-1990

control structure (software) A construct that determines the flow of control through a computer program. *See also:* computer program; conditional control structure; flow of control. (C/SE) 729-1983s

control switch A manually operated switching device for controlling power-operated devices. *Note:* It may include signaling, interlocking, etc., as dependent functions. (PE/SWG) C37.100-1992

control switchboard A type of switchboard including control, instrumentation, metering, protective (relays) or regulating equipment for remotely controlling other equipment. Control switchboards do not include the primary power circuit-switching devices or their connections. (PE/SWG) C37.100-1992, C37.21-1985r

control-switching point (telephone switching systems) A switching entity arranged for routing and control in the distance dialing network, at which intertoll trunks are interconnected. (COM) 312-1977w

control system (1) (broadly) An assemblage of control apparatus coordinated to execute a planned set of controls. *See also:* control. (IA) [60]

(2) A system in which a desired effect is achieved by operating on the various inputs to the system until the output, which is a measure of the desired effect, falls within an acceptable range of values. *See also:* closed-loop control system; control; network analysis; open-loop control system; transfer function. (MAG/PEL) 111-1984w, 264-1977w

(3) **(automatic control)** A system in which deliberate guidance or manipulation is used to achieve a prescribed value of a variable. *Note:* It is subdivided into a controlling system and a controlled system. (PE) [3]

(4) A system in which a desired effect is achieved by operating on inputs until the output, which is a measure of the desired effect, falls within an acceptable range of values. *See also:* automatic control; closed-loop control; open-loop control. (C/MAG) 264-1977w, 610.2-1987

control system, adaptive A control system within which automatic means are used to change the system parameters in a way intended to improve the performance of the control system. *See also:* control system, feedback. (IA/IM/PE) [120], [3], [60], [69]

control system, automatic A control system that operates without human intervention. *See also:* control system, feedback. (IM/PE) [120], [3]

control system, automatic feedback A feedback control system that operates without human intervention. *See also:* control system, feedback. (IM/PE) [120], [3]

control system, cascade A control system in which the output of one subsystem is the input for another subsystem. *See also:* control system, feedback. (IM/PE) [120], [3]

control system, closed-loop A control system in which the controlled quantity is measured and compared with a standard representing the desired performance. Any deviation from the standard is fed back into the control system in such a sense that it will reduce the deviation of the controlled quantity from the standard. *Note:* In automatic generation control, the controlled quantities are frequency, unit generation, and net interchange. (PE) 94-1970w

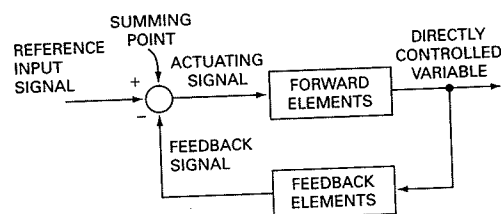
control system, coarse-fine A control system that uses some elements to reduce the difference between the directly controlled variable and its ideal value to a small value and that uses other elements to reduce the remaining difference to a smaller value. (IA) [60]

control system, dual-mode A control system in which control alternates between two predetermined modes. *Note:* The con-

dition for change from one mode to the other is often a function of the actuating signal. One use of dual-mode action is to provide rapid recovery from large deviations without incurring large overshoot. *See also:* control system, feedback. (PE) [3]

control system, duty factor (automatic control) A control system in which the signal to the final controlling element consists of periodic pulses whose duration is varied to relate, in some prescribed manner, the time average of the signal to the actuating signal. *Note:* This mode of control differs from two-step control in that the period of the pulses in duty-factor control is predetermined. (PE) [3]

control system, feedback (1) (general) A control system that operates to achieve prescribed relationships between selected system variables by comparing functions of these variables and using the comparison to effect control. *See the diagram below.*



Simplified block diagram indicating essential elements of an automatic control system.

control system, feedback

(Std100)

(2) **(speed governing of hydraulic turbines)** A closed-loop or feedback control system is a control system in which the controlled quantity is measured and compared with a standard representing the desired value of the controlled quantity. In hydraulic governors, any deviation from the standard is fed back into the control system in such a sense that it will reduce the deviation between the controlled quantity and the standard providing negative feedback. (PE) 125-1977s

control system, floating (automatic control) A control system in which the rate of change of the manipulated variable is a continuous (or at least a piecewise continuous) function of the actuating signal. *Note:* The manipulated variable can remain at any value in its operating range when the actuating signal is zero and constant. Hence the manipulated variable is said to "float." When the forward elements in a control loop have integral control action only, the mode of control has been called "proportional-speed floating." The use of the term integral control action is recommended as a replacement for "proportional-speed floating control." *Synonym:* floating control. *See also:* control action, integral; control system, multiple-speed floating; control system, single-speed floating; neutral zone. (PE) [3]

control system, multiple-speed floating (automatic control) A form of floating control system in which the manipulated variable may change at two or more rates each corresponding to a definite range of values of the actuating signal. (PE) [3]

control system, multi-step *See:* control system, step.

control system, on-off A two-step control system in which a supply of energy to the controlled system is either on or off. *See also:* control system, feedback. (IM/PE) [120], [3]

control system, positioning (automatic control) A control system in which there is a predetermined relation between the actuating signal and the position of a final controlling element. *Note:* In a "proportional-position control system" there is a continuous linear relation between the value of the actuating signal and the position of a final controlling element. (PE) [3]

control system, ratio (automatic control) A system that maintains two or more variables at a predetermined ratio. *Note:* Frequently some function of the value of an uncontrolled vari-

control system, sampling

able is the command to a system controlling another variable.

(PE) [3]

control system, sampling Control using intermittently observed values of signals such as the feedback signal or the actuating signal. *Note:* The sampling is often done periodically. *See also:* control system, feedback.

(IM/PE) [120], [3]

control system, single-speed floating (automatic control) A floating control system in which the manipulated variable changes at a fixed rate, increasing or decreasing depending on the sign of the actuating signal. *Note:* A neutral zone of values of the actuating signal, in which no action occurs, may be used.

(PE) [3]

control system, step (automatic control) A system in which the manipulated variable assumes discrete predetermined values. *Note:* The condition for change from one predetermined value to another is often a function of the value of the actuating signal. When the number of values of the manipulated variable is two, it is called a two-step control system; when more than two, a multi-step control system.

(PE) [3]

control system, two-step A control system in which the manipulated variable alternates between two predetermined values. *Note:* A control system in which the manipulated variable changes to other predetermined value whenever the actuating signal passes through zero is called a two-step single-point control system. A two-step neutral-zone control system is one in which the manipulated variable changes to the other predetermined value when the actuating signal passes through a range of values known as the neutral zone. The neutral zone may be produced by a mechanical differential gap. The neutral zone is also called overlap, and two-step neutral-zone control overlap control. *See also:* control system, feedback.

(IM/PE) [120], [3]

control system, two-step neutral zone *See:* control system, two-step.

control system, two-step single-point *See:* control system, two-step.

control tape *See:* carriage control tape.

control terminal (base station) (mobile communication) Equipment for manually or automatically supervising a multiplicity of mobile and/or radio stations including means for calling or receiving calls from said stations. *See also:* mobile communication system.

(VT) [37]

control total *See:* hash total.

control track (electroacoustics) A supplementary track usually placed on the same medium with the record carrying the program material. *Note:* Its purpose is to control, in some respect, the reproduction of the program, or some related phenomenon. Ordinarily, the control track contains one or more tones, each of which may be modulated either as to amplitude, frequency, or both. *See also:* phonograph pickup.

(SP) [32]

control transfer instruction *See:* jump instruction.

control transformers (power and distribution transformers) Step-down transformers generally used in circuits which are characterized by low power levels and which contribute to a control function, such as in heating and air conditioning, printing, and general industrial controls.

(PE) C57.12.80-1978r

control unit (1) (digital computers) The parts that effect the retrieval of instructions in proper sequence, the interpretation of each instruction, and the application of the proper signals to the arithmetic unit and other parts in accordance with this interpretation.

(C) [20], [85]

(2) (mobile communication) (mobile station) Equipment including a microphone and/or handset and loudspeaker together with such other devices as may be necessary for controlling a mobile station. *See also:* mobile communication system.

(VT) [37]

(3) A functional unit of a computer that interprets and executes the instructions of a program in a prescribed sequence *See also:* instruction control unit; main control unit.

(C) 610.10-1994

conventionally true value

control valve (control systems for steam turbine-generator units) Those valves that control the energy input to the turbine and that are actuated by a controller through the control mechanism.

(PE) 122-1985a

control variable *See:* loop-control variable.

control voltage The voltage applied to the operating mechanism of a device to actuate it, usually measured at the control power terminals of the mechanism.

(PE/SWG) C37.100-1992

control winding (1) (rotating machinery) An excitation winding that carries a current controlling the performance of a machine. *See also:* asynchronous machine.

(PE) [9]

(2) (saturable reactor) A winding by means of which a controlling magnetomotive force is applied to the core. *See also:* magnetic amplifier.

(EEC/PE) [119]

convection current In an electron stream, the time rate at which charge is transported through a given surface. *See also:* electron emission.

(ED) [45], 161-1971w

convection-current modulation The time variation in the magnitude of the convection current passing through a surface, or the process of directly producing such a variation. *See also:* electron emission.

(ED) 161-1971w

convection heater A heater than dissipates its heat mainly by convection and conduction.

(EEC/PE) [119]

convective discharge (effluve) (electrical wind) (medical electronics) (static breeze) The movement of a visible or invisible stream of particles carrying away charges from a body that has been charged to a sufficiently high voltage.

(EMB) [47]

convective heat release The heat contained in the hot gases produced in a fire.

(DEI) 1221-1993

convenience outlet *See:* receptacle.

convention Any practice that is not formally standardized, but which is adopted by a group in a given situation. For example, programmers usually adopt the convention of indenting subordinate instructions in a routine so that the structure of the program is more easily visualized. *See also:* standard.

(C) 610.10-1994, 610.7-1995

conventional BIL (basic lightning impulse insulation level) The crest value of a standard lightning impulse for which the insulation shall not exhibit disruptive discharge when subjected to a specific number of applications of this impulse under specified conditions, applicable specifically to non-self-restoring insulations.

(C/PE) 1313.1-1996

conventional BSL (basic switching impulse insulation level) The crest value of a standard switching impulse for which the insulation does not exhibit disruptive discharge when subjected to a specific number of impulses under specified conditions, applicable to non self-restoring insulations.

(C/PE) 1313.1-1996

conventional deviation of the disruptive discharge voltage (2) The difference between the 50% and 16% disruptive discharge voltages.

(PE) 4-1995

conventional-electrode coaxial detector (germanium gamma-ray detectors) A coaxial detector in which the outer contact is an n-type layer.

(NPS) 325-1986s

conventionally (true value of a quantity) The commonly accepted best estimate of the value of that quantity. This and its associated uncertainty will normally be determined by a national or transfer standard, or by a reference instrument that has been calibrated against a national or transfer standard, or by measurement quality assurance (MQA) with a national laboratory or qualified secondary laboratory.

(NI) N42.17B-1989r

conventionally cooled (rotating machinery) A term referring to windings in which the heat generated within the principal portion of the windings must flow through the major ground insulation before reaching the cooling medium.

(PE/REM) [115], [9]

conventionally true value The best estimate of the value determined by a primary or secondary standard, or by a reference instrument that has been calibrated against a primary or secondary standard.

(NI) N42.20-1995

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deviation distortion

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device control character

the documentation defining the affected item. *Contrast:* engineering change; waiver. *See also:* configuration control.

(C) 610.12-1990

(2) (navigation aid terms) The angle between the magnetic meridian and the axis of a compass card. Indicates the offset of the compass card from magnetic north.

(AE) 172-1983w

(3) (automatic control) Any departure from a desired or expected value or pattern.

(IA/PE) [3], [60], [69]

(4) (metric practice) Variation from a specified dimension or design requirement, usually defining upper and lower limits. *See also:* tolerance.

(QUL) 268-1982s

(5) (nuclear power quality assurance) A departure from specified requirements.

(PE) [124]

deviation distortion (data transmission) Distortion in an FM receiver due to inadequate bandwidth and inadequate amplitude modulation rejection, or inadequate discriminator linearity.

(PE) 599-1985w

deviation factor (1) (rotating machinery) (wave) The ratio of the maximum difference between corresponding ordinates of the wave and of the equivalent sine wave when the waves are superposed in such a way as to make this maximum difference as small as possible. *Note:* The equivalent sine wave is defined as having the same frequency and the same root-mean-square value as the wave being tested. *See also:* direct-axis synchronous impedance.

(PE) [9]

(2) (electrical measurements in power circuits) The deviation factor is the ratio of the maximum difference between corresponding ordinates of the wave and of the equivalent sine wave to the maximum ordinate of the equivalent sine wave when the waves are superposed in such a way as to make this maximum difference as small as possible. The equivalent sine wave is defined as having the same frequency and the same rms value as the wave being tested.

(PE) 120-1989

deviation, frequency *See:* frequency deviation.

deviation from a sine wave (converter characteristics) (harmonic control and reactive compensation of static power converters) (self-commutated converters) A single number measure of the distortion of a sinusoid due to harmonic components. It is equal to the ratio of the absolute value of the maximum difference between the distorted wave and the fundamental to the crest value of the fundamental. *See also:* maximum theoretical deviation from a sine wave.

(IA) 519-1992, 936-1987w

deviation integral, absolute (automatic control) The time integral of the absolute value of the system deviation following a stimulus specified as to location, magnitude, and time pattern. *Note:* The stimulus commonly employed is a step input.

(PE) [3]

deviation ratio (data transmission) (frequency-modulation systems) The ratio of the maximum frequency deviation to the maximum modulating frequency of the system.

(PE) 599-1985w

deviation sensitivity (1) (navigation aid terms) The rate of change of course indication with respect to the change of displacement from the course line.

(AE) 172-1983w

(2) (frequency-modulation receivers) The least frequency deviation that produces a specified output power.

188-1952w

deviation, steady-state (control) The system deviation after transients have expired. *Note:* For the purpose of this definition, drift is not considered to be a transient. *See also:* deviation.

(IA/IM) [120], [60]

deviation system (control) The instantaneous value of the ultimately controlled variable minus the command. *Note:* The use of system error to mean a system deviation with its sign changed is deprecated. *Synonym:* system overshoot. *See also:* deviation.

(IA/PE) [60], 421-1972s

deviation, transient (control) The instantaneous value of the ultimately controlled variable minus its steady-state value. *Synonym:* transient overshoot. *See also:* deviation.

(IA/PE) [60], 421-1972s

device (1) (software) A mechanism or piece of equipment designed to serve a purpose or perform a function.

(C) 610.12-1990

(2) (FASTBUS acquisition and control) (FASTBUS device) Any equipment capable of connecting to a segment and responding to the mandatory features of the FASTBUS protocol.

960-1993

(3) (696 interface devices) (general system) A circuit or logical group of circuits resident on one or more boards capable of interacting with other such devices through the bus.

(C/MM) 696-1983w

(4) (nuclear power generating station) An item of electric equipment that is used in connection with, or as an auxiliary to, other items of electric equipment. (For example, as used in IEEE Std 649-1980, a device is a starter, contactor, circuit breaker, relay, etc.)

(COM/PE) 344-1975s, 455-1985r, 649-1980s

(5) (programmable instrumentation) A component of a system that does not function as the system-controller but typically receives program messages from and sends response messages to the controller. A device may optionally have the capability to receive control from the controller and become the controller-in-charge of the system. A device meets all the requirements stated in IEEE Std 488.2-1987. *See also:* controller; system.

(IM) 488.2-1992

(6) (packaging machinery) A unit of an electrical system which is intended to carry but not consume electrical energy.

(IA) 333-1980w

(7) A medical instrument or other device used to generate data on a particular patient.

(EMB) 1073.3.1-1994

(8) A hardware unit that is capable of performing some specific function.

(BA/C) 1275-1994

(9) A component of an VXIbus system. Normally, a device will consist of one VXIbus board. However, multiple-slot devices and multiple-device modules are permitted. Some examples of devices are computers, multimeters, multiplexers, oscillators, operator interfaces, and counters.

(C/MM) 1155-1992

(10) In networking, a unit that provides a means for inputting and outputting data over the transmission medium. *See also:* station.

(C) 610.7-1995

(11) A mechanism or piece of equipment designed to serve a purpose or perform a function.

(C) 610.10-1994

(12) A computer peripheral or an object that appears to the application as such.

(C/PA) 1003.5-1992, 1003.5b-1995, 9945-1-1996

(13) (electrical equipment) An operating element such as a relay, contactor, circuit breaker, switch, valve, or governor used to perform a given function in the operation of electrical equipment.

(PE/SWG/SUB) C37.1-1994, C37.100-1992

device address The (32-m)-bit identifying number assigned to a FASTBUS device that is compared with the signals on the AD lines during a logical primary address cycle of a FASTBUS operation. The device address is formed by the group and module address fields. The (remaining) low-order m bits are assigned to the internal address field.

960-1993

device alias A shorthand representation for a device path.

(BA/C) 1275-1994

device arguments The component of a node name that is provided to a package's open method to provide additional device-specific information.

(BA/C) 1275-1994

device class-broadcast Selective broadcast-class specified by CSR#7. Controls device response to subsequent cycles within the broadcast.

960-1993

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.

(EMB) 1073.3.1-1994, 1073.4.1-1994

device control character (data management) A control character used for the control of auxiliary devices associated with a data processing system or data communication system; for

interconnected delta connection

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interconnected delta connection (power and distribution transformers) A three-phase connection using six windings (two per phase) connected in a six-sided circuit with six bushings to provide a fixed phase-shift between two three-phase circuits without change in voltage magnitude. *Note:* The interconnected delta connection is sometimes described as a "hexagon autotransformer," or a "squashed delta."

(PE) C57.12.80-1978r

interconnected star connection of polyphase circuits See: zig-zag connection of polyphase circuits.

interconnected system (A) (electric power system) A system consisting of two or more individual power systems normally operating with connecting tie lines. *See also:* power system. (B) Two or more power systems connected by transmission facilities.

(PE) 94-1991

interconnecting channel (of a supervisory system) The transmission link, such as the direct wire, carrier, or microwave channel (including the direct current, tones, etc.) by which supervisory control or indication signals or selected telemeter readings are transmitted between the master station and the remote station or stations, in a single supervisory system.

(PE/SWG) C37.100-1992

interconnection (1) The physical plant and equipment required to facilitate the transfer of electric energy between two or more entities. It can consist of a substation and an associated transmission line and communications facilities or only a simple electric power feeder. (PE/SUB) 1109-1990

(2) The facilities that connect two power systems or control areas.

(PE) 858-1993

interconnection device *See:* adapter.

interconnection diagram (packaging machinery) A diagram showing the connections between the terminals in the control panel and outside points, such as connections to motors and auxiliary devices.

(IA) 333-1980w

interconnection tie A feeder interconnecting two electric supply systems. *Note:* The normal flow of energy in such a feeder may be in either direction. *See also:* center of distribution.

(PE/T&D) [10]

interconnect space The address space used for board identification, system configuration, and board specific functions such as testing and diagnostics.

(C/MM) 1296-1987s

interconnect template A definition of the contents of the interconnect space of an agent.

(C/MM) 1296-1987s

interdendritic corrosion Corrosive attack that progresses preferentially along interdendritic paths. *Note:* This type of attack results from local differences in composition, that is, coring, commonly encountered in alloy castings.

(IA) [59]

interdigital magnetron A magnetron having axial anode segments around the cathode, alternate segments being connected together at one end, remaining segments connected together at the opposite end.

(ED) [45], 161-1971w

interdigital transducer (IDT) A comb-like conductive structure that is fabricated on the surface of a substrate and consists

interface**interface-CCITT**

of interleaved metal electrodes (fingers) whose function is to transform electrical energy into acoustic energy or vice versa by means of the piezoelectric effect. (UFFC) 1037-1992

interdigit interval (dial-pulse address signaling systems) (telephony) In dial-pulse signaling, an extended make interval used to separate and distinguish successive dial-pulse address digits.

(COM) 753-1983w

interdigit (interdigital) time (measuring the performance of tone address signaling systems) The time interval between successive signal present intervals during which no signal present condition exists. This time includes the signal off condition and transition intervals between signal off condition and signal present condition on both state transitions.

(COM) 752-1986w

interelectrode capacitance (j - I interelectrode capacitance of an n -terminal electrode tube) The capacitance determined from the short-circuit transfer admittance between the j th and the I th terminals. *Note:* This quantity is often referred to as direct interelectrode capacitance. *See also:* electron-tube admittances.

(ED) 161-1971w

interelectrode transadmittance (j - I interelectrode transadmittance of an n -electrode electron tube) The short-circuit transfer admittance from the j th electrode to the I th electrode. *See also:* electron-tube admittances.

(ED) 161-1971w

interelectrode transconductance (j - I interelectrode transconductance) The real part of the j - I interelectrode transadmittance. *See also:* electron-tube admittances.

(ED) 161-1971w

interelement influences (polyphase wattmeters) The percentage change in the recorded value that is caused solely by the action of the stray field of one element upon the other element. *Note:* This influence is determined at the specified frequency of calibration with rated current and rated voltage in phase on both elements or such lesser value of equal currents in both elements as gives end-scale deflection. Both current and voltage in one element shall then be reversed, and, for rating purposes, one-half the difference in the readings in percent is the interelement influence. *See also:* accuracy rating.

(EEC) [102], [111]

interexchange carrier In the United States, a common carrier limited by law to carry telephone traffic between local exchange and transport areas.

(C) 610.7-1995

interexchange channel A direct channel or circuit between exchanges.

(C) 610.7-1995

interface (1) (696 interface devices) A shared electrical boundary between parts of a computer system, through which information is conveyed.

(C/MM) 696-1983w

(2) (microprocessor operating systems) A shared boundary between two layers or modules of software.

(C/MM) 855-1985s

(3) (watt-hour meters) The means for transmitting information between the register and peripheral equipment.

(ELM) C12.13-1985s

(4) (general) A shared boundary.

(C) [20], [85]

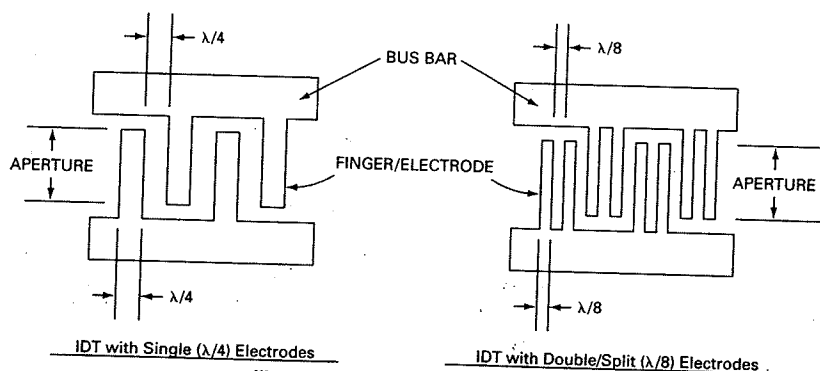


illustration of transducer parameters

(5) (Class 1E equipment alternating station) A junction between two pieces of equipment and another equipment, including connection boxes, splices, terminations, grommets, gaskets, etc.

(6) (programmable instrument) A boundary between a considered system and parts of a system, through which information is exchanged.

(7) (test, measurement, shared boundary) A shared boundary involving a connection between two equipment. The boundary includes the type, quantity, and location of connection circuits and the test points interchanged via those circuits.

(8) (A) (data transmission) A boundary between two physical connecting devices. The boundary may include physical surfaces and spacings, electrical connections, or electrical levels, impedances, or power levels. (B) (data transmission) A boundary between two systems. The specification of the interconnection function of the interconnection is to be interchanged.

(9) (A) (software) A shared boundary between two systems. Information is passed. (B) (software) A shared component that connects two systems for the purpose of passing information. (C) (software) A shared component that connects two systems for the purpose of passing information. (D) (software) To serve as a shared component as in definition (B).

(10) (STEBus) A shared boundary between two or more systems, or between two or more systems, through which information is exchanged.

(11) (SBX bus) A shared boundary between two or more parts of systems, through which information is exchanged.

(12) (electromechanical) A shared boundary between two communications between two systems.

(13) A device placed between two systems and test equipment. It is one of the following functions: work connection, control, or access for the reference connection.

(14) (MULTIBUS) A shared boundary between two or more agents of a computer system, through which information is conveyed.

(15) A junction or junction between two pieces of equipment and another equipment or equipment. The surfaces include, as applicable, the driven equipment and the force transmitted to the cooling system connection. *See also:* data-transfer.

(16) A shared boundary between two or more systems. The standard specifies the service characteristics and behavior. The standard is a contract in mutual obligation between two or more systems that assures a stable definition of the boundary.

(17) Hardware or software boundary between two or more physical entities.

interface-CCITT

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interface plane

(5) (Class 1E equipment and circuits) (nuclear power generating station) A junction or junctions between a Class 1E equipment and another equipment or device. (Examples: connection boxes, splices, terminal boards, electrical connections, grommets, gaskets, cables, conduits, enclosures, etc.) (PE) 323-1974s, 380-1975w

(6) (programmable instrumentation) A common boundary between a considered system and another system, or between parts of a system, through which information is conveyed. (IM) 488.1-1987r

(7) (test, measurement, and diagnostic equipment) A shared boundary involving the specification of the interconnection between two equipments or systems. The specification includes the type, quantity and function of the interconnection circuits and the type and form of signals to be interchanged via those circuits. *See also:* adapter. (MIL) [2]

(8) (A) (data transmission) A common boundary; for example, a physical connection between two systems or two devices. The boundary may be mechanical such as the physical surfaces and spacings in mating parts, modules, components, or subsystems, or electrical, such as matching signal levels, impedances, or power levels of two or more subsystems. (B) (data transmission) A concept involving the specification of the interconnection between two equipments or systems. The specification includes the type, quantity, and function of the interconnection circuits and the type and form of signals to be interchanged by these circuits. (PE) 599-1985w

(9) (A) (software) A shared boundary across which information is passed. (B) (software) A hardware or software component that connects two or more other components for the purpose of passing information from one to the other. (C) (software) To connect two or more components for the purpose of passing information from one to the other. (D) (software) To serve as a connecting or connected component as in definition (B). (C) 610.12-1990

(10) (STEBus) A shared boundary between two or more systems, or between two or more elements within a system, through which information is conveyed. (C/MM) 1000-1987r, 796-1983r

(11) (SBX bus) A shared boundary, between two systems or parts of systems, through which information is transferred. (C/MM) 959-1988r

(12) (electromechanical watthour meters) The means for communications between devices. (ELM) C12.15-1990

(13) A device placed between the line output of a digital telephone set and test equipment. The device performs at least one of the following functions: simulation of a normal network connection, control of the telephone set under test, or access for the reference codec to the digital voice signal. (COM) 269-1992

(14) (MULTIBUS) A shared boundary between modules or agents of a computer system, through which information is conveyed. (C/MM) 1296-1987s

(15) A junction or junctions between a Class 1E equipment and another equipment or device. (For motors, typical interfaces include, as applicable: mechanical mounting connection to the driven equipment and the motor mounting to its base, and force transmitted to the motor, electrical connection, cooling system connections, and lubrication system connection. *See also:* data-transfer interface; user interface. (PE) 334-1994

(16) A shared boundary between two functional entities. A standard specifies the services in terms of the functional characteristics and behavior observed at the interface. The standard is a contract in the sense that it documents a mutual obligation between the service user and provider and assures a stable definition of that obligation. (C/PA) 14252-1996

(17) Hardware or software that provides a point of communication between two or more processes, persons, or other physical entities. (C) 610.10-1994, 610.7-1995

(18) A shared boundary between two objects such as devices, systems, or networks, across which information is passed. *See also:* data-transfer interface; user interface. (C/PE/SUB) 610.10-1994, 999-1992

(19) Either the MA interface or the MT interface without distinction, or one of the two in particular. (C/PA) 1224.1-1993

(20) A junction or junctions between a Class 1E equipment and another equipment or device. (For motors, typical interfaces include, as applicable: mechanical mounting connection to the driven equipment and the motor mounting to its base, any force transmitted to the motor, electrical connection, cooling system connections, and lubrication system connection.) (PE) 334-1994

(21) In software development, a relationship among two or more entities (such as software item - software item, software item - hardware item, software item - user, or software unit - software unit) in which the entities share, provide, or exchange data. An interface is not a software item, software unit, or other system component; it is a relationship among them. (C/SE) J-STD-016-1995

(22) A shared boundary between two layers or modules of software. (C/MM) 855-1990

interface-CCITT (data transmission) The present European, and possible world standard, for interface requirements between data processing terminal equipment and data communication equipment. The CCITT standard resembles very closely the American EIA, Standard RS-232-C. This standard is considered mandatory in Europe and on the other continents. (PE) 599-1985w

interface control (1) (software, configuration management) The process of identifying all functional and physical characteristics relevant to the interfacing of two or more configuration items provided by one or more organizations, and ensuring that proposed changes to these characteristics are evaluated and approved prior to implementation. *See also:* baseline; configuration audit; configuration control; configuration control board; configuration identification; configuration item; configuration management; configuration status accounting; software library. (C/SE) 610.12-1990, 828-1983s

(2) (software) (DoD usage) In configuration management, the administrative and technical procedures and documentation necessary to identify functional and physical characteristics between and within configuration items provided by different developers, and to resolve problems concerning the specified interfaces. *See also:* configuration control. (C) 610.12-1990

interface—EIA standard RS-232-C (data transmission) A standardized method adopted by the Electronic Industries Association to ensure uniformity of interface between data communication equipment and data processing terminal equipment. The standard interface has been generally accepted by a great majority of the manufacturers of data transmission and business equipment. (PE) 599-1985w

interface error An error condition caused by hardware incompatibility, software incompatibility or other incompatibilities between any two items of equipment. (C) 610.10-1994

interface—MIL STD 188B (data transmission) The standard method of interface established by the Department of Defense and is presently mandatory for use by the departments and agencies of the Department of Defense for the installation of all new equipment. This standard provides the interface requirements for interconnection between data communication security devices, data processing equipment, or other special military terminal devices. (PE) 599-1985w

interface, operating (connector) The surfaces at which a connector is normally separated. (See the corresponding figure.) 386-1977s

interface operation *See:* operation.

interface plane An assigned plane on the bottom surface of the module connector from which the connector's electrical pins