US008966144B2

(12) **United States Patent**
Tasler

(10) **Patent No.: US 8,966,144 B2**
(45) **Date of Patent: *Feb. 24, 2015**

(54) **ANALOG DATA GENERATING AND PROCESSING DEVICE HAVING A MULTI-USE AUTOMATIC PROCESSOR**

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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 1333 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/467,073**

(22) Filed: **Aug. 24, 2006**

(65) **Prior Publication Data**

US 2007/0005823 A1 Jan. 4, 2007

Related U.S. Application Data

(60) Continuation of application No. 11/078,778, filed on Mar. 11, 2005, now abandoned, and a continuation of application No. 10/219,105, filed on Aug. 15, 2002, now Pat. No. 6,895,449, which is a division of application No. 09/331,002, filed on Jun. 14, 1999, now Pat. No. 6,470,399.

(30) **Foreign Application Priority Data**

Mar. 4, 1997 (DE) 19708755
Mar. 3, 1998 (WO) PCT/EP98/01187

(51) **Int. Cl.**
G06F 13/12 (2006.01)
G06F 13/38 (2006.01)
G06F 3/06 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 13/385*** (2013.01); ***G06F 3/0605*** (2013.01); ***G06F 3/0607*** (2013.01);
(Continued)

(58) **Field of Classification Search**
USPC 710/1, 15, 63
See application file for complete search history.

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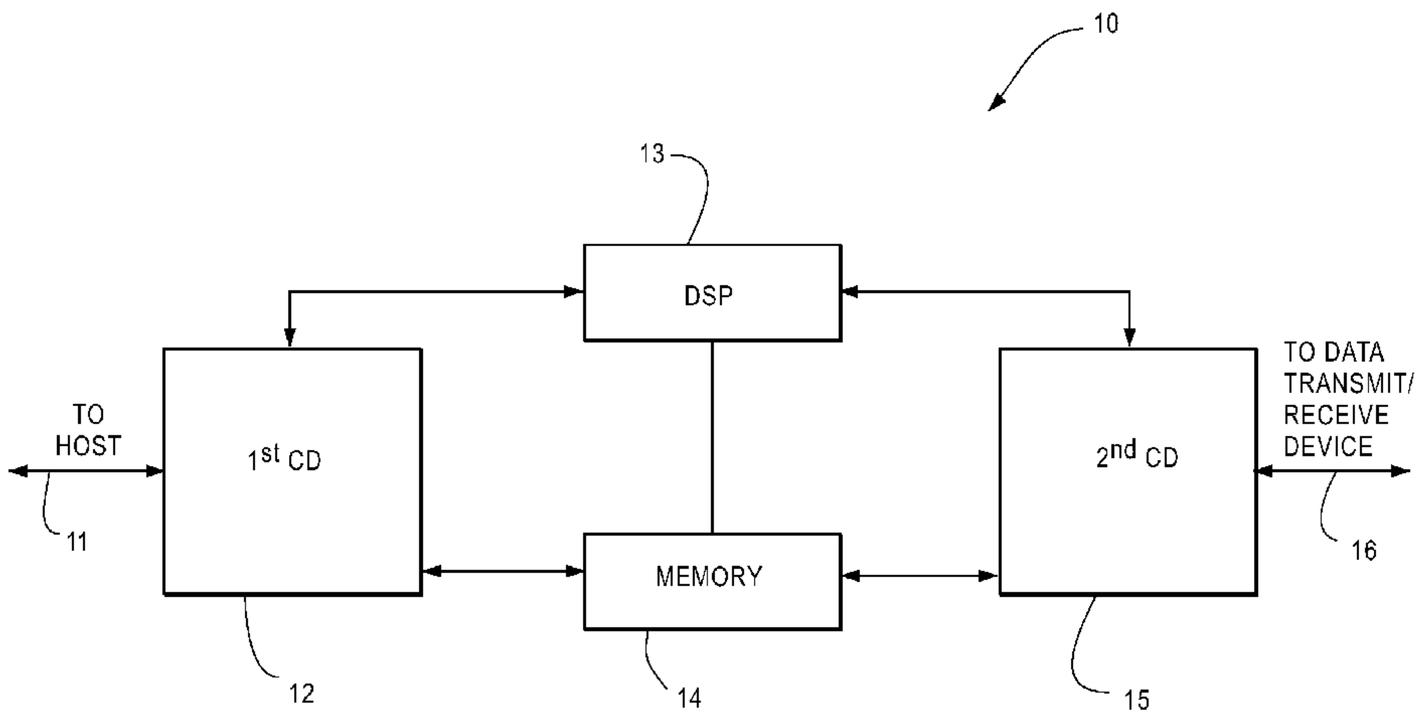
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(57) **ABSTRACT**

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.

87 Claims, 2 Drawing Sheets



(52) **U.S. Cl.**
CPC ***G06F3/0613*** (2013.01); ***G06F 3/0661*** (2013.01); ***G06F 3/0664*** (2013.01); ***G06F 3/0676*** (2013.01); ***G06F 13/387*** (2013.01)
USPC **710/63**

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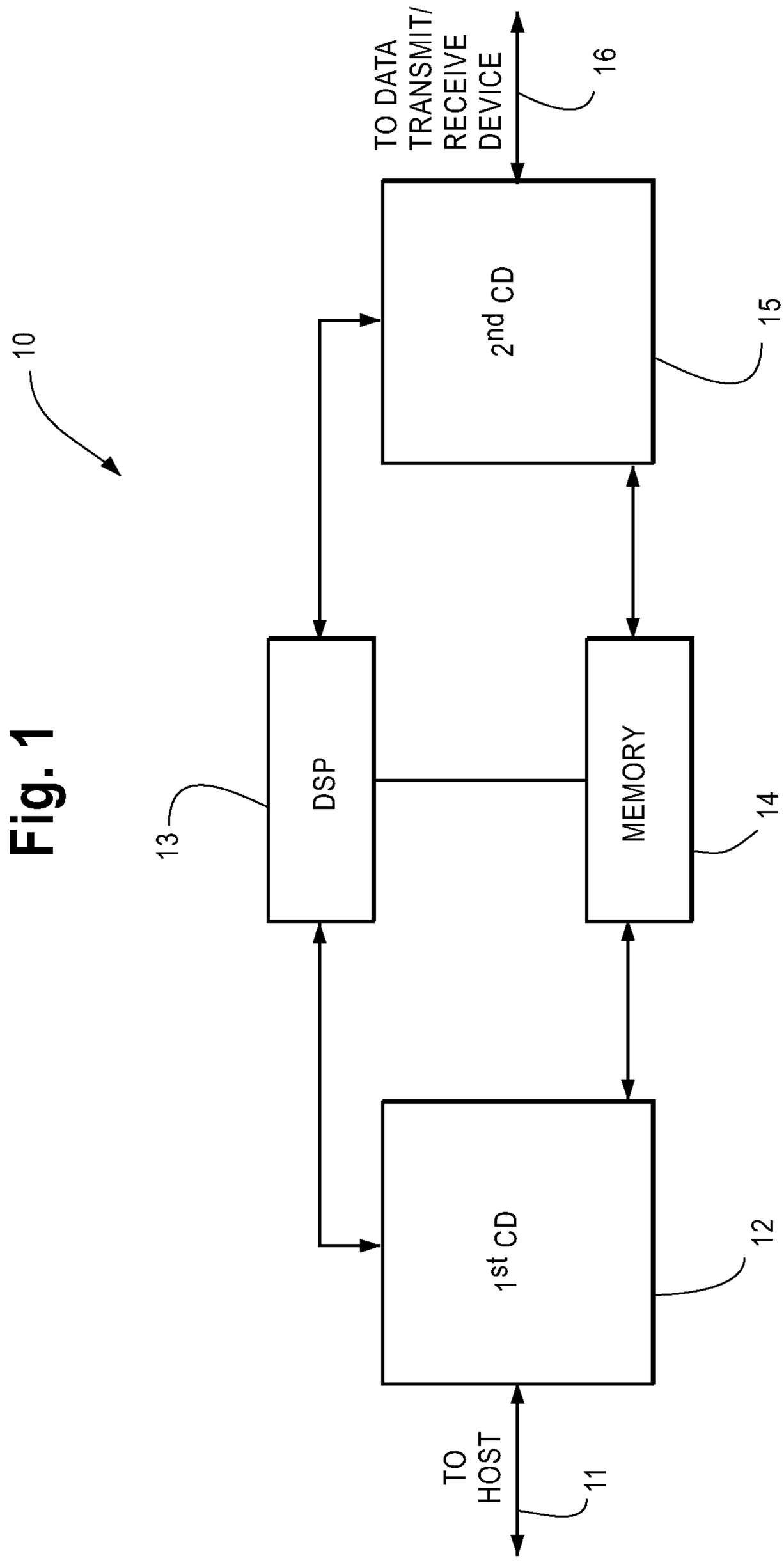

10
TO DATA TRANSMIT/ RECEIVE DEVICE
16
2nd CD
15
DSP
13
MEMORY
14
1st CD
12
TO HOST
11

Fig. 1

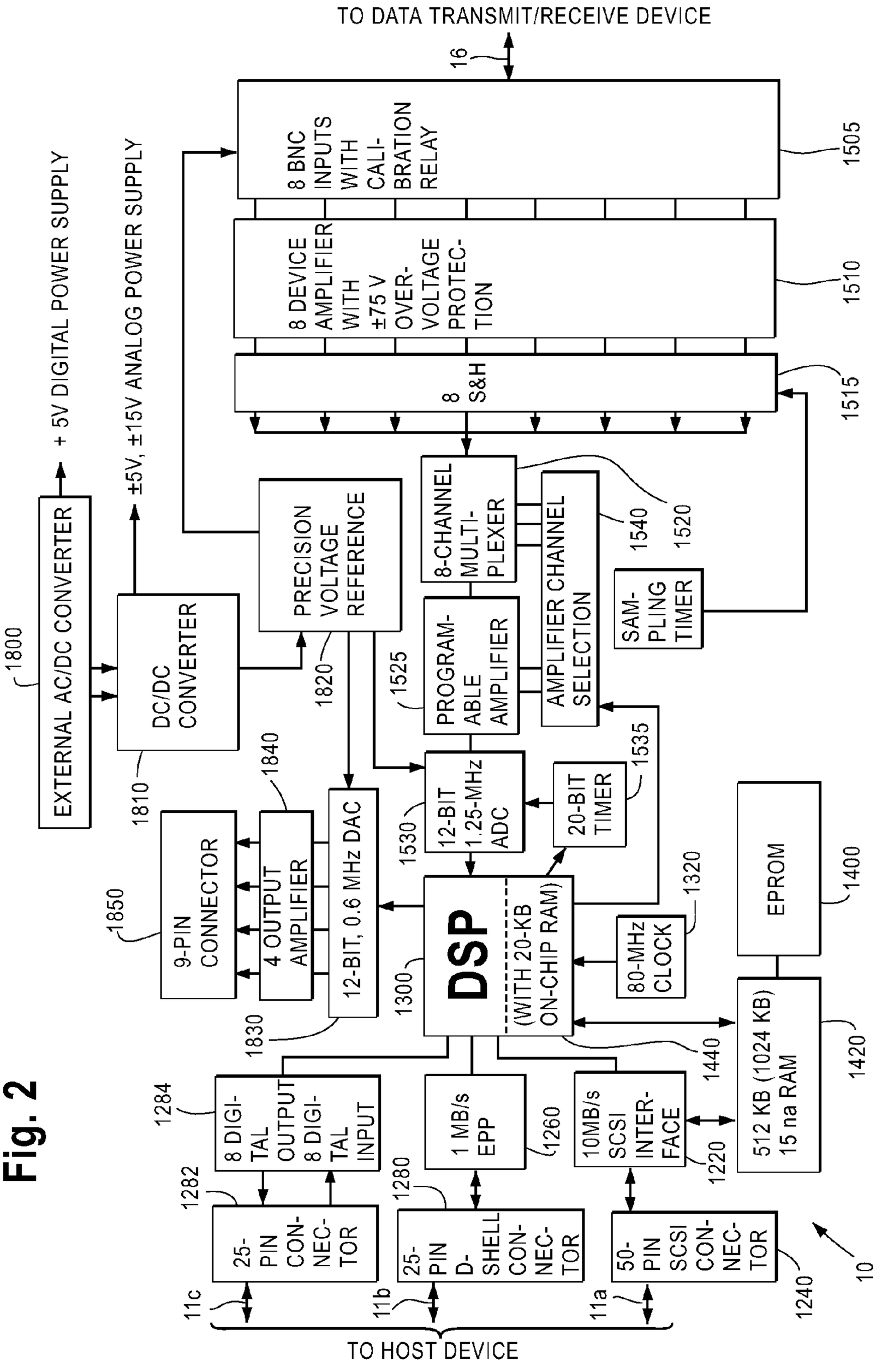

TO DATA TRANSMIT/RECEIVE DEVICE
16
8 BNC INPUTS WITH CALI-BRATION RELAY
1505
8 DEVICE AMPLIFIER WITH ±75 V OVER-VOLTAGE PROTEC-TION
1510
8 S&H
1515
8-CHANNEL MULTI-PLEXER
1540
AMPLIFIER CHANNEL SELECTION
1520
SAM-PLING TIMER
PRECISION VOLTAGE REFERENCE
1820
1525
PROGRAM-ABLE AMPLIFIER
12-BIT 1.25-MHz ADC
1530
20-BIT TIMER
1535
1840
12-BIT, 0.6 MHz DAC
1830
4 OUTPUT AMPLIFIER
9-PIN CONNECTOR
1850
1810
DC/DC CONVERTER
EXTERNAL AC/DC CONVERTER
1800
+ 5V DIGITAL POWER SUPPLY
±5V, ±15V ANALOG POWER SUPPLY
DSP
(WITH 20-KB ON-CHIP RAM)
1300
80-MHz CLOCK
1320
EPROM
1400
512 KB (1024 KB) 15 na RAM
1420
1440
10MB/s SCSI INTER-FACE
1220
1 MB/s EPP
1260
8 DIGI-TAL OUTPUT 8 DIGI-TAL INPUT
1284
25-PIN CON-NEC-TOR
1282
25-PIN D-SHELL CON-NEC-TOR
1280
50-PIN SCSI CON-NEC-TOR
1240
11c
11b
11a
TO HOST DEVICE
10

Fig. 2

ANALOG DATA GENERATING AND PROCESSING DEVICE HAVING A MULTI-USE AUTOMATIC PROCESSOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Ser. No. 11/078,778, filed Mar. 11, 2005, which is a continuation of application Ser. No. 10/219,105, filed Aug. 15, 2002, now U.S. Pat. No. 6,895,449, which is a divisional of application Ser. No. 09/331,002, filed Jun. 14, 1999, now U.S. Pat. No. 6,470,399.

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 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 is it 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 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 personal computer memory card association (PCMIA) 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 Institute of Electrical and Electronics (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 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 modified frequency modulation (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 (FDD) 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 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.

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 personal computers (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, compact disk read-only memory (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 a small computer systems interface (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 basic input/output system (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 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 a detailed block diagram of an interface device according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

It should be understood that the title of this section of this specification, namely, "Detailed Description Of The Invention", relates to a requirement of the United States Patent Office, and does not imply, nor should be inferred to limit the subject matter disclosed herein.

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 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 in 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.

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 erasable programmable read-only memory (EPROM) or electrically erasable programmable read-only memory (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 random access memory (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 fast Fourier transformation (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**.

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.

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 interoperation 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 alternating current to direct current (AC/DC) converter **2230** which delivers a digital supply voltage of .+−.5 V and is attached to a direct current to direct current (DC/DC) converter **2240** which can deliver analog supply voltages of .+−.5 V and .+−.15 V as required for the interface device **10**. Further, the direct current to direct current (DC/DC) converter controls a precision voltage reference **2250** which controls the 8 Bayonet Neill Concelman (BNC) inputs **1505** and the ADC **1530** as well as a digital/analog converter (DAC) **2260** which permits, via an output amplifier block with 4 output amplifiers **2270** and a 9-pin connector **2280**, 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 **2280**, 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 **11***a*, **11***b* and **11***c* 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 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. TuV (Technischer Überwachongsverein), UL (Underwriters Laboratories), CSA (Canadian Standard Association). 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 military standards (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 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 analog data generating and processing device (ADGPD), comprising:

an input/output (i/o) port;

a program memory;

a data storage memory;

a sensor designed to transmit data;

a processor operatively interfaced with the i/o port, the program memory, the data storage memory and the sensor;

wherein the processor is adapted to be involved in a data generation process by which the sensor generates analog data, the analog data is processed, and the processed analog data is stored in the data storage memory as at least one file of digitized analog data;

wherein the processor also is adapted to be involved in an automatic recognition process in which, when the i/o port is operatively interfaced with a multi-purpose interface of a computer, the processor executes at least one instruction set stored in the program memory and thereby causes at least one parameter which provides identification information regarding the ADGPD to be automatically sent through the i/o port and to the multi-purpose interface of the computer (a) without requiring any end user to load any software onto the computer at any time, (b) without requiring any end user to interact with the computer to set up a file system in the ADGPD at any time, (c) before a time when the computer is able to receive the at least one file of digitized analog data from the data storage memory and (d) regardless of the identity of a manufacturer of the computer, wherein the at least one parameter is consistent with the ADGPD being responsive to commands issued from a customary driver;

wherein the processor is further adapted to be involved in an automatic file transfer process in which, when the i/o port is operatively interfaced with the multi-purpose interface of the computer, and after the at least one parameter has been received by the multi-purpose interface of the computer, the processor executes at least one other instruction set stored in the program memory and thereby causes the at least one file of digitized analog data to be transferred to the computer regardless of the identity of the manufacturer of the computer and without requiring any user-loaded file transfer enabling software to be loaded on or installed in the computer at any time.

2. The ADGPD of claim **1**, wherein the i/o port, the program memory, the data storage memory, and the processor form an interface device that is designed to have the analog data transferred to it from the sensor.

3. The ADGPD of claim **2**, wherein the interface device comprises a portable interface device.

4. The ADGPD of claim **2**, wherein the interface device comprises a flexible interface device.

5. The ADGPD of claim **2**, wherein the interface device comprises a universal interface device.

6. The ADGPD of claim **2**, wherein the interface device comprises a stand alone interface device.

7. The ADGPD of claim **2**, wherein the interface device includes a parallel logic circuit.

8. The ADGPD of claim **2**, wherein the interface device includes a SCSI interface circuit.

9. The ADGPD of claim **2**, wherein the interface device is designed so that the sensor is detachable from the interface device.

10. The ADGPD of claim **2**, wherein the interface device allows for a plurality of different data transmit devices to be attached thereto and detached therefrom.

11. The ADGPD of claim **2**, wherein the sensor is designed to be readily disconnected from the interface device.

12. The ADGPD of claim **2**, wherein the interface device is designed so that a user can attach the sensor to or detach the sensor from the interface device.

13. The ADGPD of claim **1**, wherein the i/o port comprises a parallel port.

14. The ADGPD of claim **1**, wherein the i/o port comprises a SCSI connector.

15. The ADGPD of claim 1, wherein the i/o port is adapted to be interfaced with a multi-purpose interface of an external computing device only by means of a cable.

16. The ADGPD of claim 1, wherein the i/o port is adapted to be physically connected to a multi-purpose interface of an external computing device by a cable.

17. The ADGPD of claim 1, wherein the sensor comprises a data transmit/receive device.

18. The ADGPD of claim 17, wherein the data transmit/receive device is designed for two-way communication with a host device.

19. The ADGPD of claim 17, wherein the data transmit/receive device is designed for one-way or two-way communication with a host device.

20. The ADGPD of claim 17, wherein the data transmit/receive device is designed to receive data from a host device.

21. The ADGPD of claim 1, wherein the processor is designed so that the sensor is detachable therefrom.

22. The ADGPD of claim 1, wherein the processor allows for a plurality of different data transmit devices to be attached thereto and detached therefrom.

23. The ADGPD of claim 1, wherein the sensor is designed to be readily disconnected from the processor.

24. The ADGPD of claim 1, wherein the processor is designed so that a user can attach the sensor to or detach the sensor therefrom.

25. The ADGPD of claim 1, wherein the sensor comprises a multimeter.

26. The ADGPD of claim 1, wherein the sensor includes at least first and second transducers both of which are designed to transmit data.

27. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being an information storage device other than a magnetic floppy disk drive.

28. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being a mass storage device.

29. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being responsive to a SCSI inquiry command.

30. The ADGPD of claim 1, wherein the at least one parameter is not consistent with the true nature of the ADGPD.

31. The ADGPD of claim 1, wherein the at least one parameter does not indicate that the ADGPD includes the sensor.

32. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being an input/output device.

33. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being an input/output device located within an interior of a housing of a personal computing device.

34. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being adapted to operate in a manner consistent with a hard disk drive.

35. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being a hard disk drive.

36. The ADGPD of claim 1, wherein the at least one parameter is consistent with the ADGPD being an input/output device that is customary in a host device.

37. The ADGPD of claim 1, wherein the data storage memory comprises a temporary memory.

38. The ADGPD of claim 1, wherein the data storage memory comprises a semiconductor based memory.

39. The ADGPD of claim 1, wherein the data storage memory comprises random access memory.

40. The ADGPD of claim 1, wherein the data storage memory comprises a single memory device.

41. The ADGPD of claim 1, wherein the program memory comprises electronically programmable read only memory.

42. The ADGPD of claim 1, wherein the processor is adapted to, when the i/o port is operatively interfaced with the multi-purpose interface of the computer, and after the at least one parameter has been sent to the multi-purpose interface of the computer, execute at least one set of computer code stored in the program memory and thereby cause ADGPD file system information to be automatically sent to the i/o port (a) without requiring any end user to load any software onto the computer at any time, (b) without requiring any end user to interact with the computer to set up a file system in the ADGPD at any time, (c) before a time when the computer is able to receive the at least one file of digitized analog data from the data storage memory and (d) regardless of the identity of a manufacturer of the computer.

43. The ADGPD of claim 42, wherein the ADGPD file system information comprises at least an indication of the type of a file system that is used to store the at least one file of digitized analog data in the data storage memory.

44. The ADGPD of claim 42, wherein the at least one parameter is consistent with the ADGPD being an information storage device other than a magnetic floppy disk drive.

45. The ADGPD of claim 44, wherein the at least one parameter is consistent with the ADGPD being a mass storage device.

46. The ADGPD of claim 45,

wherein the processor and the program memory are adapted to be configured to cause, after the at least one parameter has been sent to the i/o port, file allocation table information to be sent to the i/o port,

wherein the processor and the program memory are adapted to be configured to cause a virtual boot sequence to be sent to the i/o port which includes at least information that is representative of a number of sectors of a storage disk, and

wherein the file allocation table information includes at least a start location of a file allocation table.

47. The ADGPD of claim 46, wherein the at least one parameter is consistent with the ADGPD being adapted to operate in a manner consistent with a hard disk drive.

48. The ADGPD of claim 47, wherein the at least one parameter is consistent with the ADGPD being a hard disk drive.

49. The ADGPD of claim 1, wherein the processor includes a single central processing unit.

50. The ADGPD of claim 1, wherein the program memory comprises a single memory device.

51. The ADGPD of claim 1, wherein the program memory is formed in a single chip.

52. The ADGPD of claim 1, wherein the processor comprises a microprocessor.

53. The ADGPD of claim 1, wherein the processor comprises a single microprocessor.

54. The ADGPD of claim 1, wherein the processor comprises a digital signal processor.

55. The ADGPD of claim 1, wherein the processor comprises a single digital signal processor.

56. The ADGPD of claim 1, wherein the processor and the program memory are adapted to be configured to initiate a process by which the at least one file of digitized analog data stored in the data storage memory are directly transferred to an input/output device by means of the i/o port.

57. The ADGPD of claim 56, wherein the processor and the program memory are adapted to allow an aspect of operation of the ADGPD other than the transfer of at least some of the

at least one file of digitized analog data from the data storage memory to the i/o port to be controlled by means of the computer.

58. The ADGPD of claim **1**, wherein the ADGPD comprises at least a portion of a medical device.

59. The ADGPD of claim **1**, wherein the ADGPD comprises at least a portion of a data acquisition system.

60. The ADGPD of claim **1**, wherein the ADGPD is designed for use with an external computing device that has an operating system that is designed by a particular software company.

61. The ADGPD of claim **1**, wherein the processor is adapted to, when it is involved in the automatic recognition process, execute the at least one instruction set to thereby directly cause the at least one parameter regarding the ADGPD to be automatically sent.

62. The ADGPD of claim **1**, wherein the processor is adapted to be employed in the automatic recognition process.

63. The ADGPD of claim **1**, wherein the processor is adapted to be directly involved in all aspects of the automatic recognition process.

64. The ADGPD of claim **1**, wherein the processor is adapted to be employed in the data generation process.

65. The ADGPD of claim **1**, wherein the processor is adapted to be directly involved in all aspects of the data generation process.

66. The ADGPD of claim **1**, wherein the analog data is, when the analog data generation process takes place, processed by being subject to a fast Fourier transform.

67. The ADGPD of claim **1**, wherein the processed analog data is stored in the data storage memory as only one file of digitized analog data.

68. The ADGPD of claim **1**, wherein the ADGPD is designed so that both the analog data generation and automatic file transfer processes, when they occur, take place only after the automatic recognition process has been executed.

69. The ADGPD of claim **1**, wherein the analog data generation and automatic file transfer processes, when they occur, at least partially overlap in time.

70. The ADGPD of claim **1**, wherein the ADGPD is designed so that the analog data generation process, when it occurs, takes place only after the i/o port is interfaced with the computer.

71. The ADGPD of claim **1**, wherein the sensor is designed for two-way communication with the computer.

72. The ADGPD of claim **1**, wherein the sensor is designed for one-way or two-way communication with the computer.

73. The ADGPD of claim **1**, wherein the sensor is designed to receive data from the computer.

74. The ADGPD of claim **1**, wherein the sensor is designed to receive signals from the computer.

75. The ADGPD of claim **1**, wherein the ADGPD is designed so that at least one aspect of how the ADGPD creates the at least one file of digitized analog data can be controlled by means of commands that are issueable from a source external to the ADGPD.

76. The ADGPD of claim **75**, wherein the ADGPD is designed so that the at least one aspect is controlled by means of a configuration file.

77. The ADGPD of claim **1**, wherein the ADGPD is designed to be responsive to a test unit ready command.

78. The ADGPD of claim **1**, wherein the set of instructions executed by the processor in the automatic recognition process is stored in a single memory device.

79. The ADGPD of claim **1**, wherein the set of instructions executed by the processor in the automatic file transfer process is stored in a single memory device.

80. A combination comprising the ADGPD of claim **1** and a computer.

81. The combination of claim **80**, wherein the computer includes a driver for an input/output device customary in a host device.

82. The combination of claim **80**, wherein the computer includes at least one customary driver.

83. The combination of claim **80**, wherein the computer includes at least one driver for an input/output device customary in a host device.

84. An analog data generating and processing device (ADGPD), comprising:

an input/output (i/o) port;

a program memory;

a data storage memory;

a sensor designed to transmit data;

a processor operatively interfaced with the i/o port, the program memory, the data storage memory and the sensor;

wherein the processor is adapted to be involved in a data generation process by which the sensor generates analog data, the analog data is processed, and the processed analog data is stored in the data storage memory as at least one file of digitized analog data;

wherein the processor also is adapted to be involved in an automatic recognition process in which, when the i/o port is operatively interfaced with a multi-purpose interface of a computer, the processor executes at least one instruction set stored in the program memory and thereby causes at least one parameter which provides identification information regarding the ADGPD to be automatically sent through the i/o port and to the multi-purpose interface of the computer (a) without requiring any end user to load any software onto the computer at any time, (b) without requiring any end user to interact with the computer to set up a file system in the ADGPD at any time, (c) before a time when the computer is able to receive the at least one file of digitized analog data from the data storage memory and (d) regardless of the identity of a manufacturer of the computer;

wherein the processor is adapted to, when the i/o port is operatively interfaced with the multi-purpose interface of the computer, and after the at least one parameter has been sent to a multi-purpose interface of the computer, execute at least one other instruction set stored in the program memory and thereby cause ADGPD file system information to be automatically sent to the i/o port (a) without requiring any end user to load any software onto the computer at any time, (b) without requiring any end user to interact with the computer to set up a file system in the ADGPD at any time, (c) before a time when the computer is able to receive the at least one file of digitized analog data from the data storage memory and (d) regardless of the identity of a manufacturer of the computer, the ADGPD file system information comprises at least an indication of the type of a file system that is used to store the at least one file of digitized analog data in the data storage memory;

wherein the processor is further adapted to be involved in an automatic file transfer process in which, when the i/o port is operatively interfaced with the multi-purpose interface of the computer, and after the at least one parameter has been sent from the i/o port to the multi-purpose interface of the computer, the processor executes at least one set of computer code stored in the program memory and thereby causes the at least one file of digitized analog data to be transferred to the computer

regardless of the identity of the manufacturer of the computer and without requiting any user-loaded file transfer enabling software to be loaded on or installed in the computer at any time;

wherein the at least one parameter is consistent with the ADGPD being a mass storage device that operates in a manner consistent with a hard disk drive;

wherein the at least one parameter is further consistent with the ADGPD being responsive to commands issued from a customary driver;

wherein the processor and the program memory are adapted to be configured to cause, after the at least one parameter has been sent to the i/o port, file allocation table information to be sent to the i/o port, the file allocation table information including at least a start location of a file allocation table;

wherein the processor and the program memory are adapted to be configured to cause a virtual boot sequence to be sent to the i/o port which includes at least information that is representative of a number of sectors of a storage disk.

85. The ADGPD of claim **84**, wherein the at least one parameter is consistent with the ADGPD being a hard disk drive.

86. An analog data generating and processing device (ADGPD), comprising:

an input/output (i/o) port;

a program memory;

a data storage memory;

a sensor designed to transmit data;

a processor operatively interfaced with the i/o port, the program memory, the data storage memory and the sensor;

wherein the processor is adapted to be involved in a data generation process by which the sensor generates analog data, the analog data is processed, and the processed analog data is stored in the data storage memory as at least one file of digitized analog data;

wherein the processor also is adapted to be involved in an automatic recognition process

(1) in which, when the i/o port is operatively interfaced with a multi-purpose interface of a first computer, the processor executes at least one instruction set stored in the program memory and thereby causes at least one parameter to be automatically sent through the i/o port and to the multi-purpose interface of the first computer (a) without requiring any end user to load any software onto the first computer at any time, (b) without requiring any end user to interact with the first computer to set up a file system in the ADGPD at any time, and (c) before a time when the first computer is able to receive the at least one file of digitized analog data from the data storage memory, and

(2) in which, when the i/o port is operatively interfaced with a multi-purpose interface of a second computer that is manufactured by a company other than the company that manufactured the first computer, the processor executes the at least one instruction set stored in the program memory and thereby causes the at least one parameter to be automatically sent through the i/o port and to the multi-purpose interface of the second computer (a) without requiring any end user to load any software onto the second computer at any time, (b) without requiring any end user to interact with the second computer to set up a file system in the ADGPD at any time, and (c) before a time when the second computer is abl to receive the at least one file of digitized analog data from the data storage memory;

wherein the at least one parameter provides identification information regarding the ADGPD;

wherein the at least one parameter is further consistent with the ADGPD being responsive to commands issued from a customary driver;

wherein the processor is further adapted to be involved in an automatic file transfer process

(1) in which, when the i/o port is operatively interfaced with the multi\-purpose interface of the first computer, and after the at least one parameter has been received by the multi-purpose interface of the first computer, the processor executes at least one other instruction set stored in the program memory and thereby causes the at least one file of digitized analog data to be transferred to the first computer without requiring any user-loaded file transfer enabling software to be loaded on or installed in the computer at any time, and

(2) in which, when the i/o port is operatively interfaced with the multi-purpose interface of the second computer, and after the at least one parameter has been received by the multi-purpose interface of the second computer, the processor executes the at least one other instruction set stored in the program memory and thereby causes the at least one file of digitized analog data to be transferred to the second computer without requiring any user-loaded file transfer enabling software to be loaded on or installed in the computer at any time.

87. The ADGPD of claim **86**, wherein the at least one parameter is consistent with the ADGPD being a mass storage device.

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