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(54) **Multipurpose sensor port**

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(73) Proprietor: **Masimo Corporation**
Irvine, CA 92618 (US)

(72) Inventors:
- **Al-Ali, Ammar**
  Tustin, California 92782 (US)
- **Smith, Robert A.**
  Lake Forest, California 92630 (US)
- **McCarthy, Rex. J.**
  Santa Ana, CA 92705 (US)

(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München (DE)

(56) References cited:
WO-A2-03/073927 **US-A- 5 058 588**
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Description

Background of the Invention

[0001] A pulse oximeter is a physiological instrument that provides noninvasive measurements of arterial oxygen saturation along with pulse rate. To make these measurements, a pulse oximeter performs a spectral analysis of the pulsatile component of arterial blood so as to determine the relative concentration of oxygenated hemoglobin, the major oxygen carrying constituent of blood. Pulse oximeters provide early detection of decreases in the arterial oxygen supply, reducing the risk of accidental death and injury. As a result, these instruments have gained rapid acceptance in a wide variety of medical applications, including surgical wards, intensive care units, general wards and home care.

[0002] FIG. **1** illustrates a pulse oximetry system **100** having a sensor **110** and a monitor **120.** The monitor **120** may be a multi-parameter patient monitor or a standalone, portable or handheld pulse oximeter. Further, the monitor **120** may be a pulse oximeter **200,** such as an OEM printed circuit board (PCB), integrated with a host instrument including a host processor **122,** as shown. The sensor **110** attaches to a patient and receives drive current from, and provides physiological signals to, the pulse oximeter **200.** An external computer (PC) **130** may be used to communicate with the pulse oximeter **200** via the host processor **122.** In particular, the PC **130** can be used to download firmware updates to the pulse oximeter **200** via the host processor **122,** as described below.

[0003] FIG. **2** illustrates further detail of the pulse oximetry system **100.** The sensor **110** has emitters **112** and a detector **114.** The emitters **112** typically consist of a red light emitting diode (LED) and an infrared LED that project light through blood vessels and capillaries underneath a tissue site, such as a fingernail bed. The detector **114** is typically a photodiode positioned opposite the LEDs so as to detect the emitted light as it emerges from the tissue site. A pulse oximetry sensor is described in U.S. Patent 6,088,607 entitled "Low Noise Optical Probe," which is assigned to Masimo Corporation, Irvine, CA and incorporated by reference herein.

[0004] As shown in FIG. **2,** the pulse oximeter **200** has a preamp **220,** signal conditioning **230,** an analog-to-digital converter (ADC) **240,** a digital signal processor (DSP) **250,** a drive controller **260** and LED drivers **270.** The drivers **270** alternately activate the emitters **112** as determined by the controller **260.** The preamp **220,** signal conditioning **230** and ADC **240** provide an analog front-end that amplifies, filters and digitizes the current generated by the detector **114,** which is proportional to the intensity of the light detected after tissue absorption in response to the emitters **112.** The DSP **250** inputs the digitized, conditioned detector signal **242** and determines oxygen saturation, which is based upon the differential absorption by arterial blood of the two wavelengths projected by the emitters **112.** Specifically, a ratio of detected red and infrared intensities is calculated by the DSP **250,** and arterial oxygen saturation values are empirically determined based upon the ratio obtained. Oxygen saturation and calculated pulse rate values are communicated to the host processor **122** for display by the monitor **120** (FIG. 1). A pulse oximeter is described in U.S. Patent 6,236,872 entitled "Signal Processing Apparatus," which is assigned to Masimo Corporation, Irvine, CA.

[0005] Further shown in FIG. **2,** the pulse oximeter **200** has a sensor port **210** and a communications port **280.** The sensor port **210** includes a connector and associated input and output signals and provides an analog connection to the sensor **110.** In particular, the sensor port **210** transmits a drive signal **212** to the LED emitters **112** from the LED drivers **270** and receives a physiological signal **214** from the photodiode detector **114** in response to the LED emitters **112,** as described above. The communication port **280** also includes a connector and associated input and output signals and provides a bi-directional communication path **282** between the pulse oximeter **200** and the host processor **122.** The communication path **282** allows the DSP **250** to transmit oxygen saturation and pulse rate values to the monitor **120** (FIG. **1**), as described above. The communication path **282** also allows the DSP firmware to be updated, as described below.

[0006] Additionally shown in FIG. **2,** the pulse oximeter **200** has a micro-controller **290** and a flash memory **255.** The flash memory **255** holds the stored program or firmware that executes on the DSP **250** to compute oxygen saturation and pulse rate. The micro-controller **290** controls data transfers between the DSP **250** and the host processor **122.** In particular, to update the DSP firmware, the firmware is uploaded into the PC **130** (FIG. 1), which downloads the firmware to the host processor **122.** In turn, the host processor **122** downloads the firmware to the micro-controller **290,** which downloads it to the DSP **250.** Finally, the DSP **250** writes the firmware to the flash memory **255.**

[0007] US 6 584 336 shows a pulse oximeter having an LED drive path, a detector signal path, a signal processor and a sensor port. WO 03/073927 shows a pulse oximetry system comprising a host instrument, an encryption interface cable and a sensor.

Summary of the Invention

[0008] To update the firmware in a pulse oximeter, particularly firmware on an OEM PCB integrated into a host instrument, requires a circuitous path using multiple protocols and multiple processors developed by different companies. Some of the protocols and processor interfaces are non-standard, requiring custom programming for different instruments. This is particularly problematic when the instruments are part of an installed base at various medical facilities. Further, some pulse oximeter products, such as handheld products, may not have a communications port for connecting to an external computer, and firmware upgrades would typically require returning the instrument to the factory.

[0009] Every pulse oximeter has a sensor port, which provides access to a DSP via one or more signal paths. Therefore, it is desirable to utilize a sensor port for downloading pulse oximetry firmware to the DSP. It is also desirable to provide this sensor port capability in existing instruments without hardware modification. Utilizing a sensor port in this manner would alleviate an instrument manufacturer from having to provide download communication capability between a host processor and an OEM PCB and would allow easy field upgrades of all instruments, including handhelds.

[0010] The present invention relates to a physiological measurement method according to claim 1 and to a physiological measurement system according to claim 5.

[0011] The present invention is defined by the independent claims and the dependent claims define preferred embodiments. Aspects, embodiments and examples which do not fall under the appended claims do not form part of the present invention.

[0012] One aspect of a multipurpose sensor port is a physiological measurement method comprising a sensor port adapted to connect with an analog sensor, and a digital data source connected to the sensor port. An identifier associated with said data source is read, where the identifier is indicative that the data source is connected to the sensor port in lieu of the analog sensor. Digital data is then received over the sensor port.

[0013] The digital data may be compiled in a signal processor. Where the digital data are instructions executable by the signal processor, the data may then be written from the signal processor into a firmware memory. The instructions may be uploaded to a PC, which is attached to a PC interface that is attached to the sensor port. Alternatively, the instructions are stored into a nonvolatile memory that is in communications with the sensor port.

[0014] The digital data may be processed as a physiological signal.

[0015] Another aspect of a multipurpose sensor port is a physiological measurement system having a sensor port adapted to connect to a sensor and a data source. A reader is configured to identify which of the sensor and the data source is connected to the sensor port. A data path is configured to communicate an analog signal associated with the sensor and digital data associated with the data source to a signal processor according to the reader. A firmware memory may be configured to provide instructions to the signal processor. The signal processor is programmed to download the instructions from the data source and store the instructions in the memory. The instructions are executable by the signal processor so as to extract a physiological measurement from the analog signal. The data source may be a PC interfaced to the sensor port, where the instructions are uploaded to the PC. Alternatively, the data source is a nonvolatile memory adapted to communicate with the sensor port, where the instructions being stored in a nonvolatile memory.

[0016] A first physiological measurement may be derivable by the signal processor from the analog signal, and a second physiological measurement may be derivable by the signal processor from the digital data. A drive path may be configured to communicate stored data associated with a physiological measurement to a digital device connected to the sensor port. The stored data may be trend data and/or log data maintained in memory that can be accessed by the signal processor.

[0017] A drive path may be configured to communicate acknowledgement data in conjunction with the communication of the digital data.

[0018] Yet another aspect of a multipurpose sensor port is a physiological measurement method where a drive path is provided that is adapted to activate emitters so as to transmit optical radiation through a fleshy medium having flowing blood. A signal path is provided that is adapted to communicate a detector response to the optical radiation after attenuation by the fleshy medium, where the response is indicative of optical characteristics of the flowing blood. Output digital data is transmitted over at least a portion of the drive path. The output digital data may be read from a memory having trend data and/or log data. Input digital data may be received over at least a portion of the signal path, and receipt of that input digital data may be acknowledged with the output digital data. The input digital data may be stored for use as signal processing instructions.

<u>Brief Description of the Drawings</u>

[0019]

FIG. **1** is a general block diagram of a prior art pulse oximeter system utilizing an OEM printed circuit board (PCB);

FIG. **2** is a detailed block diagram of a prior art pulse oximeter system;

FIGS. **3A-D** are general block diagrams of a multipurpose sensor port connected to an analog sensor, a digital data source, or both;

FIG. **4** is a general block diagram of a multipurpose sensor port having various digital data source inputs;

FIG. **5** is a block diagram of a multipurpose sensor port configured to download pulse oximeter firmware;

FIG. **6** is a DSP firmware memory map;

FIG. 7 is a detailed block diagram of a multipurpose sensor port embodiment and associated signal and data paths;

FIG. **8** is a flowchart of a digital data receiver routine; and

FIG. **9** is a schematic of a RS232 interface for a multipurpose sensor port.

Detailed Description of the Preferred Embodiment

Overview

[0020] FIGS. **3A-B** illustrate a pulse oximeter **300** having a multipurpose sensor port **301** connected to an analog sensor **310** and a digital data source **320,** respectively. As shown in FIG. **3A,** if the pulse oximeter **300** determines that an analog sensor **310** is attached to the multipurpose sensor port **301,** the multipurpose sensor port **301** is operated in an analog mode and functions as a typical sensor port, described above. As shown in FIG. **3B,** if the pulse oximeter **300** determines that a digital data source **320** is attached to the multipurpose sensor port **301,** the multipurpose sensor port **301** is operated in a digital mode and functions as a digital communications device. The data source **320** may connect to a sensor port interface **330** which, in turn, connects to the sensor port **301.** The sensor port interface **330** may be used, for example, to present a standard communications interface, such as RS-232, to the data source **320.** In one embodiment, when the pulse oximeter **300** is powered up, it reads an information element or other means of identification (ID) for the device connected to the sensor port **301.** The ID identifies the device as either an analog sensor **310** or a data source **320.** A sensor information element is described in U.S. Patent 6,397,091 entitled "Manual and Automatic Probe Calibration," which is assigned to Masimo Corporation, Irvine, CA.

[0021] FIG. **3C** illustrates a sensor port embodiment where a resistor value is a device ID. A resistor **303** is located in a device **302,** which includes a sensor **310** (FIG. **3A**), data source **320** (FIG. **3B**) or interface **330** (FIG. **3B**). The sensor port **301** has a reader **304** that measures the resistor value. The reader **304** includes a voltage source **305** and a current measurement device **307,** such as a current-to-voltage converter. The voltage source **305** has a known voltage, which is applied to the resistor **303** when the device **302** is connected to the sensor port **301.** The current measurement device **307** senses the magnitude of the resulting current flowing through the resistor **303** so as to determine the resistor value and, hence, the device ID.

[0022] FIG. **3D** illustrates a pulse oximeter **300** having an analog sensor **310,** a digital data source **320** and a switch **360** connected to a multipurpose sensor port **301.** If the pulse oximeter **300** reads an ID that identifies mixed analog and digital, then the multipurpose sensor port **301** functions to transfer either an analog signal or digital data, as determined by the switch **360.** The state of the switch **360** may be determined by the data source **320,** the pulse oximeter **300** or both. In one embodiment, the pulse oximeter **300** transmits an identifiable waveform over an LED drive path **510** (FIG: **5**) that is recognized by the switch **360** as a change state command. In this manner, the pulse oximeter **300** may occasionally receive digital data from, or transmit digital data to, the data source **320.**

Applications

[0023] FIG. **4** illustrates various digital data source **320** and sensor port interfaces **330** that connect to a multipurpose sensor port **301.** In one application, a preprogrammed module **405** connects directly to the sensor port **301.** The module **405** has nonvolatile memory preprogrammed with, for example, upgrade firmware for the pulse oximeter **300.** The module **405** also has the associated electronics to readout the memory data and communicate that data to the sensor port **301.** In particular, the module **405** provides mechanical, signal level, and communication protocol compliance with the sensor port **301.**

[0024] As shown in FIG. **4,** in another application, a PC **410** connects to the sensor port **301** via a PC interface **450.** For example, the PC **410** can be used to download firmware to the pulse oximeter **300,** as described with respect to FIG. **5,** below. As another example, the PC **410** can be used to upload information from the pulse oximeter **300,** as described with respect to FIG. **6,** below. In one embodiment, the PC interface **450** provides mechanical and signal level compliance with RS-232 on the PC side and mechanical and signal level compliance with the sensor port **301** on the pulse oximeter side, as described with respect to FIG. **9,** below.

[0025] Also shown in FIG. **4,** a physiological sensor **420** other than a conventional pulse oximeter sensor is attached to the multipurpose sensor port **301.** A physiological sensor interface **460** drives the physiological sensor **420** and generates raw digital data to the sensor port **301.** In this manner, a pulse oximeter **300** can be advantageously extended to provide physiological measurements in addition to oxygen saturation and pulse rate.

[0026] Further shown in FIG. **4,** a wireless data device **430** is attached to the multipurpose sensor port **301** via a wireless interface **470.** In this manner, the pulse oximeter can be advantageously extended to wireless data I/O and wireless networks. In one embodiment, the wireless interface **470** provides mechanical and signal level compliance with a wireless standard, such as IEEE-802.11, on one side and mechanical and signal level compliance with the sensor port **301** on the pulse oximeter side.

[0027] Additionally shown in FIG. **4,** networked digital I/O devices **440** are attached to the multipurpose sensor port **301** via a network interface **480.** In one embodiment, the network interface **480** provides mechanical and signal level compliance with a network standard, such as Ethernet, on one side and mechanical and signal level compliance with the sensor port **301** on the pulse oximeter side.

Firmware Upgrade Port

[0028] FIG. **5** illustrates a multipurpose sensor port **301** configured to download pulse oximeter firmware **501.** The firmware **501** is uploaded to a PC **410** and downloaded over a standard communications bus **503** to a target pulse oximeter **300.** The standard bus **503** may be, for example, RS-232, IEEE-488, SCSI, IEEE-1394 (FireWire), and USB, to name just a few. A PC interface **450** translates the signal levels on the sensor port **301** to the signal levels of the standard bus **503,** and vice-a-versa. In particular, an output signal on the standard bus **503** is translated to a sensor port input signal **522,** and a sensor port output signal **512** is translated to an input signal on the standard bus **503.**

[0029] As shown in FIG. **5,** the pulse oximeter **300** has a detector signal path **520,** a DSP **530,** a flash memory **540** or other nonvolatile memory and a LED drive path **510,** such as described with respect to FIG. **2,** above. Data transmitted from the PC **410** is carried on the sensor port input **522,** over the detector signal path **520** to the DSP **530,** which loads the data into a flash memory **540.** Acknowledgement data is transmitted from the DSP **530,** over the LED drive path **510,** and is carried on the sensor port output **512.**

[0030] FIG. **6** illustrates a memory map **600** for the DSP flash memory **540** (FIG. **5).** The memory map **600** illustrates partitions for DSP executable instructions such as boot firmware **610,** signal processing firmware **620** and sensor port communications firmware **630** in addition to application data **640.** The boot firmware **610** executes upon DSP power-up. The boot firmware **610** initializes the DSP and loads either the signal processing firmware **620** or the communications firmware **630** into DSP program memory, depending on the device ID, as described with respect to FIGS. **3A-D,** above. The signal processing firmware **620** contains the oxygen saturation and pulse rate measurement algorithms, referred to with respect to FIGS. **1-2,** above. The communications firmware **630** contains communications protocol algorithms, such as described with respect to FIG. **8,** below. After completing its task of downloading firmware and/or uploading the applications data **640,** the communications firmware **630** loads the signal processing firmware **620** so that the DSP can perform pulse oximetry measurements.

[0031] Also shown in FIG. **6,** the application data **640** includes trend data **632,** operational logs **634** and manufacturer's logs **638,** which can be advantageously uploaded to a PC **410** (FIG. **5)** or other digital device connected to the sensor port **301** (FIG. **5).** Trend data **632** contains oxygen saturation and pulse rate measurement history. Operational logs **634** contain, for example, failure codes and event information. Failure codes indicate, for example, pulse oximeter board failures and host failures. Event information includes alarm data, such as the occurrence of probe off and low saturation events. Manufacturer's logs **638** contains, for example, service information.

[0032] FIG. **7** illustrates a multipurpose sensor port embodiment **301** incorporating an LED drive path **510,** a detector signal path **520** and a DSP **530,** which function generally as described with respect to FIG. **5,** above. The LED drive path **510** has a shift register **710,** a red LED drive **720** and an IR LED drive **730.** The shift register **710** has a data input **712,** a red control output **714** and an IR control output **718.** The DSP **530** provides serial control data on the shift register input **712** that is latched to the shift register outputs **714, 718** so as to turn on and off the LED drives **720, 730** according to a predetermined sequence of red on, IR on and dark periods. The detector signal path **520** has a preamp **740,** signal conditioning **750** and an ADC **760** that perform amplification, filtering and digitization of the detector signal **522.** The detector signal path **520** also has a comparator **770** that compares the preamp output **742** to a fixed voltage level and provides an interrupt output **774** to the DSP **530** accordingly. The comparator **770** allows the DSP to control the preamp voltage as a function of the level of the preamp signal output **742,** as described in U.S. Patent Application No. 10/351,961 entitled "Power Supply Rail Controller," filed 01/24/2003, which is assigned to Masimo Corporation, Irvine, CA and published as US 2003/0218386.

[0033] Advantageously, the comparator signal path also allows the DSP to accept serial digital data, as described with respect to FIG. 8, below.

[0034] FIG. **8** illustrates a serial data receiver **800** embodiment of one aspect of the communications firmware **630** (FIG. **6).** The data receiver **800** utilizes the detector signal path **520** (FIG. 7) described above. A DSP internal timer is initialized to generate an interrupt at the incoming data baud rate. The timer interrupt periodically starts the data receiver **800** to determine and store a single bit. The data receiver **800** polls the status of the DSP interrupt input **774** (FIG. 7), which is initialized to be level-sensitive and disabled. Thus, whenever the comparator **770** (FIG. **7)** is triggered, it will latch into a DSP interrupt pending register but will not generate an interrupt event. The timer service routine **800** polls the interrupt pending register **820.** The pending register value is determined **830.** If the value is a "1," then a zero bit has been received **840,** else a one bit has been received **850.** The received bit is stored **860** and the timer reset **870.**

[0035] FIG. **9** illustrates an RS-232 PC interface embodiment **450** having an RS-232 connector **910,** a sensor connector **920,** a voltage regulator **930** and a transceiver **940.** The voltage regulator **930** draws power from either the RS-232 **910** RTS (request to send) or DTR (data terminal ready) signal lines and provides regulated VCC power to transceiver **940.** The transceiver **940** operates on either of the sensor **920** red or IR drive signal lines to generate an RS-232 **910** RXD (receive data) signal. The transceiver **940** further operates on the **RS-232** TXD (transmit data) signal line to generate a sensor **920** detector signal.

[0036] A multipurpose sensor port has been disclosed in detail in connection with various embodiments. These embodiments are disclosed by way of examples only and are not to limit the scope of the claims that follow. One of ordinary skill in the art will appreciate many variations and modifications within the scope of the invention defined by the appended claims.

Claims

1. A physiological measurement method comprising the steps of:

providing a pulse oximeter having:

an LED drive path (510) adapted to activate emitters so as to transmit optical radiation through a fleshy medium having flowing blood;
a detector signal path (520) adapted to communicate a detector response to said optical radiation after attenuation by said fleshy medium, said response indicative of optical characteristics of said flowing blood;
a sensor port (301) adapted to be connected at a first time to an analog sensor (310) and at a second time different from the first time to a digital data source (320), said sensor port having an input in communication with said signal path and an output in communication with said drive path;
and a signal processor;

the method further comprising the steps of:

transmitting output digital data from said signal processor to the digital data source over at least a portion of said drive path; and
receiving input digital data from said digital data source and transmit it to the signal processor over at least a portion of said signal path.

2. The physiological measurement method according to claim 1 comprising the further step of acknowledging receipt of said input digital data with said output digital data.

3. The physiological measurement method according to claim 1 comprising the further step of storing said input digital data for use as signal processing instructions.

4. The physiological measurement method according to claim 1 comprising the further step of reading said output digital data from a memory having at least one of trend data and log data.

5. A physiological measurement system comprising a pulse oximeter (300) having:

a sensor port (301) adapted to be connected at a first time to an analog sensor (310) and at a second time different from the first time a digital data source (320);
a signal processor (530);
an LED drive path (510) adapted to activate emitters so as to transmit optical radiation through a fleshy medium having flowing blood;
a detector signal path (520) adapted to communicate a detector response to said optical radiation after attenuation by said fleshy medium, said response indicative of optical characteristics of said flowing blood;
a sensor port input (522) within the sensor port configured to carry digital data transmitted from a digital data source (320) over said signal path to the signal processor; and
a sensor port output (512) within the sensor port configured to carry digital data transmitted from the signal processor over said drive path to the digital data source.

6. The physiological measurement system according to claim 5 wherein the data transmitted to the digital data source is acknowledgement data.

7. The physiological measurement system according to claim 5 wherein the data transmitted from the digital data source is a firmware update.

Patentansprüche

1. Physiologisches Messverfahren mit den Schritten:

Bereitstellen eines Pulsoximeters mit:

einem LED-Treiberpfad (510), der dazu geeignet ist, Emitter zu aktivieren, um optische Strahlung durch ein fleischartiges Medium mit darin strömendem Blut zu übertragen;
einem Detektorsignalpfad (520), der dazu geeignet ist, eine Detektorantwort auf die optische Strahlung nach einer Dämpfung durch das fleischartige Medium zu kommunizieren, wobei die Antwort optische Eigenschaften des strömenden Blutes anzeigt;
einem Sensoranschluss (301), der dazu geeignet ist, zu einem ersten Zeitpunkt mit einem Analogsensor (310) und zu einem vom ersten Zeitpunkt verschiedenen zweiten Zeitpunkt mit einer Digitaldatenquelle (320) verbunden zu werden, wobei der Sensoranschluss einen mit dem Signalpfad verbundenen Eingang und einen mit dem Treiberpfad verbundenen Ausgang aufweist; und
einem Signalprozessor,

wobei das Verfahren ferner die Schritte aufweist:

Übertragen digitaler Ausgangsdaten vom

Signalprozessor an die Digitaldatenquelle über mindestens einen Teil des Treiberpfades; und
Empfangen digitaler Eingangsdaten von der Digitaldatenquelle und Übertragen der digitalen Eingangsdaten zum Signalprozessor über mindestens einen Teil des Signalpfades.

2. Physiologisches Messverfahren nach Anspruch 1, mit dem weiteren Schritt zum Bestätigen des Empfangs der digitalen Eingangsdaten mit den digitalen Ausgangsdaten.

3. Physiologisches Messverfahren nach Anspruch 1, mit dem weiteren Schritt zum Speichern der digitalen Eingangsdaten zur Verwendung als Signalverarbeitungsanweisungen.

4. Physiologisches Messverfahren nach Anspruch 1, mit dem weiteren Schritt zum Lesen der digitalen Ausgangsdaten von einem Speicher mit Trenddaten und/oder Protokolldaten.

5. Physiologisches Messsystem mit einem Pulsoximeter (300) mit:

einem Sensoranschluss (301), der dazu geeignet ist, zu einem ersten Zeitpunkt mit einem Analogsensor (310) und zu einem vom ersten Zeitpunkt verschiedenen zweiten Zeitpunkt mit einer Digitaldatenquelle (320) verbunden zu werden;
einem Signalprozessor (530);
einem LED-Treiberpfad (510), der dazu geeignet ist, Emitter zu aktivieren, um optische Strahlung durch ein fleischartiges Medium mit darin strömendem Blut zu übertragen;
einem Detektorsignalpfad (520), der dazu geeignet ist, eine Detektorantwort auf die optische Strahlung nach einer Dämpfung durch das fleischartige Medium zu kommunizieren, wobei die Antwort optische Eigenschaften des strömenden Blutes anzeigt;
einem innerhalb des Sensoranschlusss vorgesehenen Sensoranschlusseingang (522), der dafür konfiguriert ist, von einer Digitaldatenquelle (320) übertragene Digitaldaten über den Signalpfad an den Signalprozessor zu übertragen; und
einem im Sensoranschluss vorgesehenen Sensoranschlussausgang (512), der dafür konfiguriert ist, vom Signalprozessor übertragene Digitaldaten über den Treiberpfad an die Digitaldatenquelle zu übertragen.

6. Physiologisches Messsystem nach Anspruch 5, wobei die an die Digitaldatenquelle übertragenen Daten Bestätigungsdaten sind.

7. Physiologisches Messsystem nach Anspruch 5, wobei die von der Digitaldatenquelle übertragenen Daten ein Firmware-Update sind.

Revendications

1. Procédé de mesure physiologique comprenant les étapes :

de fourniture d'un sphygmo-oxymètre comportant :

un trajet de commande de DEL (510) conçu pour activer des émetteurs de manière à émettre un rayonnement optique à travers un milieu charnu dans lequel du sang circule ;
un trajet de signal de détecteur (520.) conçu pour cominuniquer une réponse de détecteur audit rayonnement optique après une atténuation par ledit milieu charnu, ladite réponse étant indicative des caractéristiques optiques dudit sang qui circule ;
un port de capteur (301) conçu pour être connecté à un premier instant à un capteur analogique (310) et à un deuxième instant différent du premier instant à une source de données numériques (320), ledit port de capteur comportant une entrée en communication avec ledit trajet de signal et une sortie en communication avec ledit trajet de commandé ;
et un processeur de signal ;

le procédé comprenant en outre les étapes :

de transmission de données numériques de sortie dudit processeur de signal à la source de données numériques sur au moins une partie dudit trajet de commande ; et
de réception de données numériques d'entrée de ladite source de données numériques et de transmission de celles-ci au processeur de signal sur au moins une partie dudit trajet de signal.

2. Procédé de mesure physiologique selon la revendication 1, comprenant l'étape supplémentaire d'acquittement de la réception desdites données numériques d'entrée avec lesdites données numériques de sortie.

3. Procédé de mesure physiologique selon la revendication 1, comprenant l'étape supplémentaire de mémorisation désdites données numériques d'entrée

pour une utilisation en tant qu'instructions de traitement de signal.

4. Procédé de mesure physiologique selon la revendication 1, comprenant l'étape supplémentaire de lecture desdites données numériques de sortie dans une mémoire comportant au moins l'une de données de tendance et de données d'enregistrement.

5. Système de mesure physiologique comprenant un sphygmo-oxymètre (300) comportant :

un port de capteur (301) conçu pour être connecté à un premier instant à un capteur analogique (310) et à un deuxième instant différent du premier instant à une source de données numériques (320) ;
un processeur de signal (530) ;
un trajet de commande de DEL (510) conçu pour activer des émetteurs de manière à transmettre un rayonnement optique à travers un milieu charnu dans lequel du sang circulé ;
un trajet de signal de détecteur (520) conçu pour communiquer une réponse de détecteur audit rayonnement optique après une atténuation par ledit milieu charnu, ladite réponse étant indicative des caractéristiques optiques dudit sang qui circule ;
une entrée de port de capteur (522) dans le port de capteur configurée pour transporter des données numériques transmises d'une source de données numériques (320) sur ledit trajet de signal au processeur de signal ; et
une sortie de port de capteur (512) dans le port de capteur configurée pour transporter des données numériques transmises du processeur de signal sur ledit trajet de commande à la source de données numériques.

6. Système de mesure physiologique selon la revendication 5, dans lequel les données transmises à la source de données numériques sont des données d'acquittement.

7. Système de mesure physiologique selon la revendication 5, dans lequel les données transmises par la source de données numériques sont une mise à jour de micrologiciel.

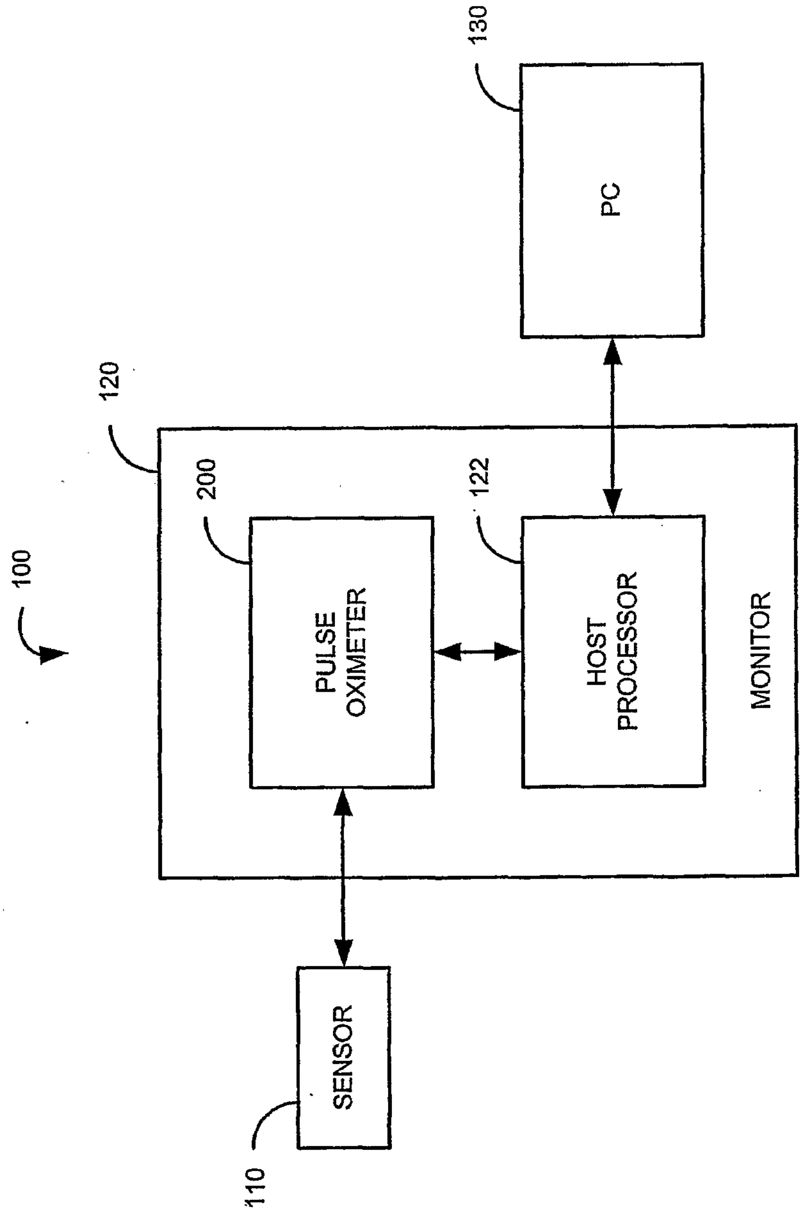


FIG. 1 (Prior Art)

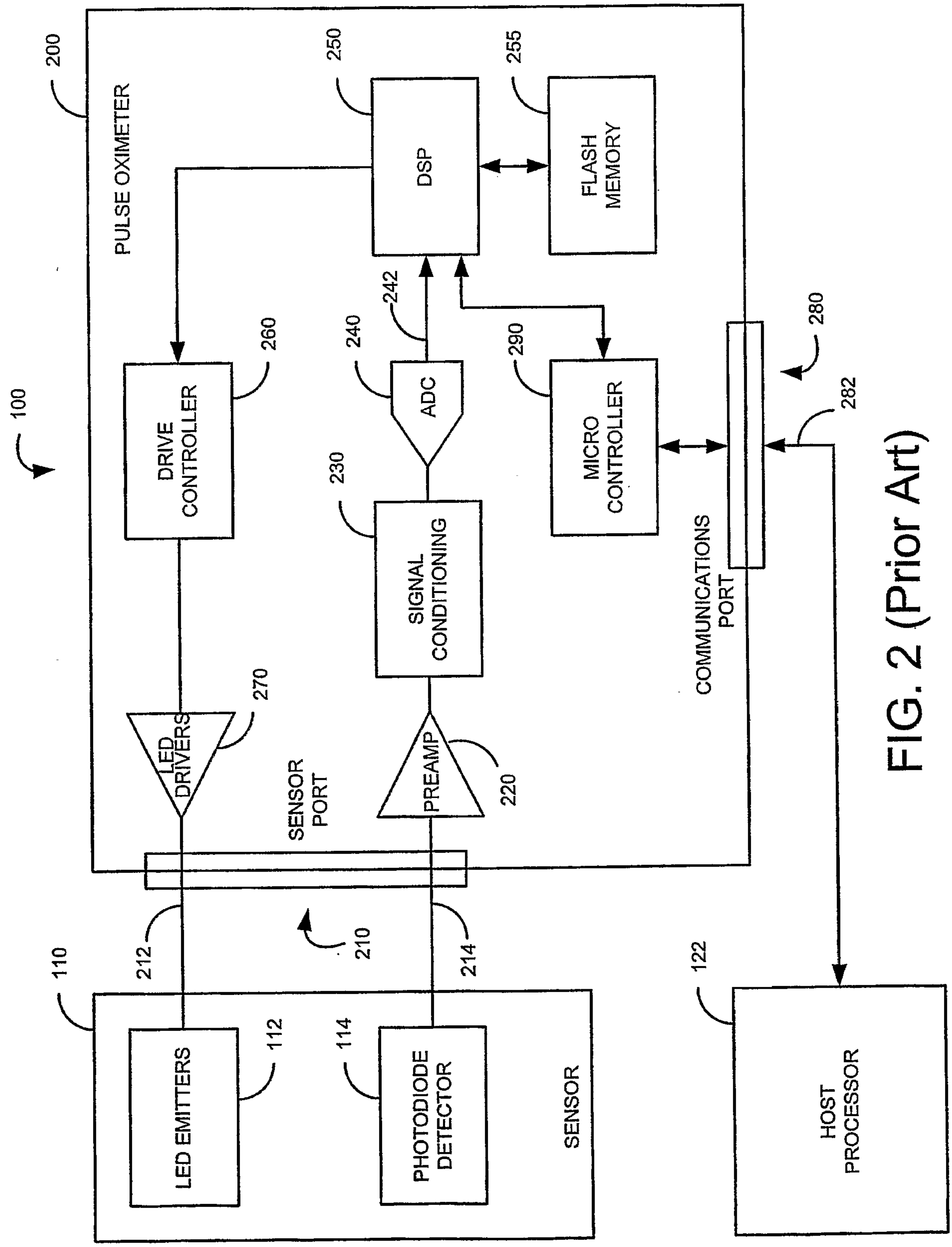


FIG. 2 (Prior Art)

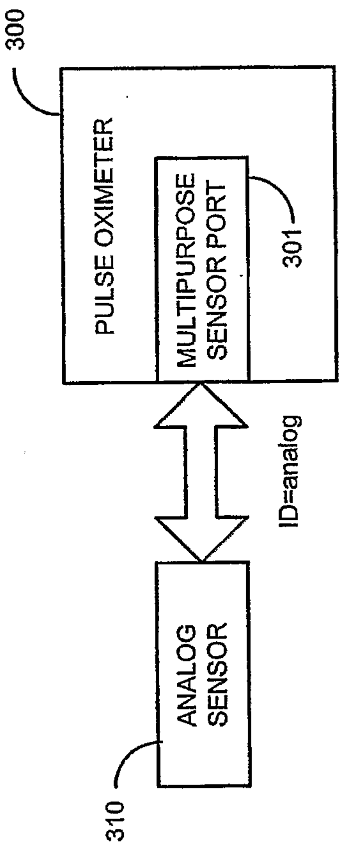

300
PULSE OXIMETER
MULTIPURPOSE SENSOR PORT
301
ID=analog
ANALOG SENSOR
310

FIG. 3A

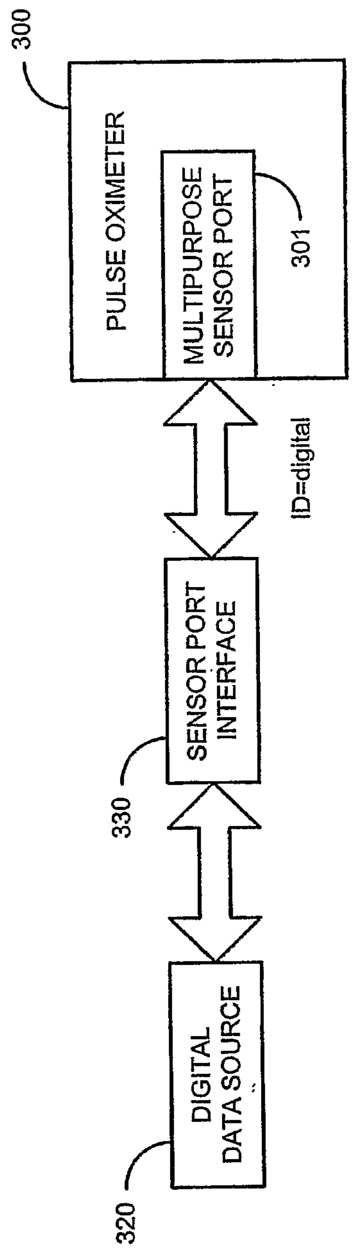

300
PULSE OXIMETER
MULTIPURPOSE SENSOR PORT
301
ID=digital
SENSOR PORT INTERFACE
330
DIGITAL DATA SOURCE
320

FIG. 3B

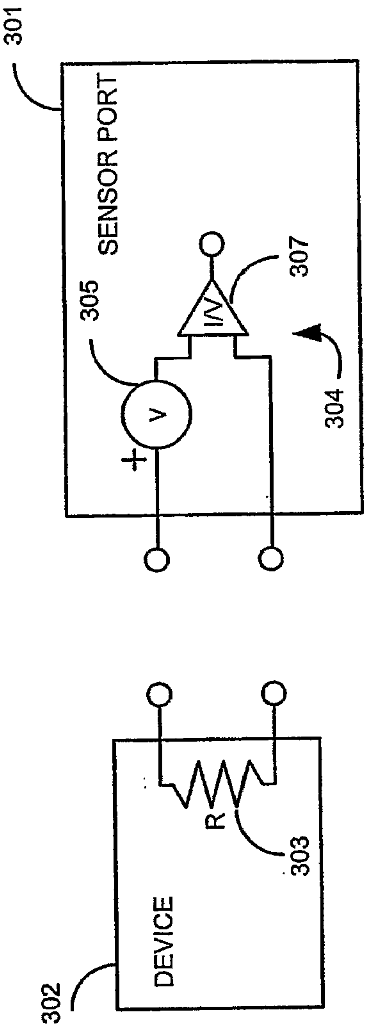

301
SENSOR PORT
305
V
I/V
307
304
302
DEVICE
R
303

FIG. 3C

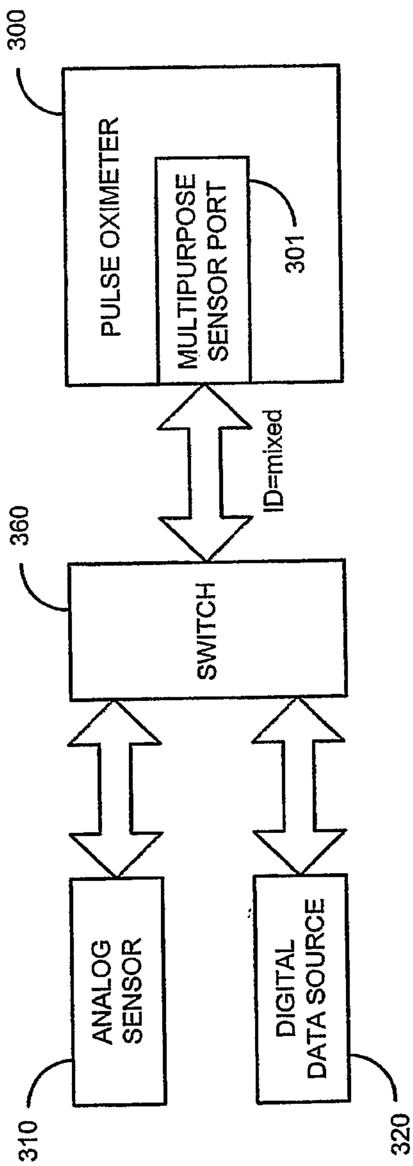

300
PULSE OXIMETER
MULTIPURPOSE
SENSOR PORT
301
ID=mixed
360
SWITCH
ANALOG
SENSOR
310
DIGITAL
DATA SOURCE
320

FIG. 3D

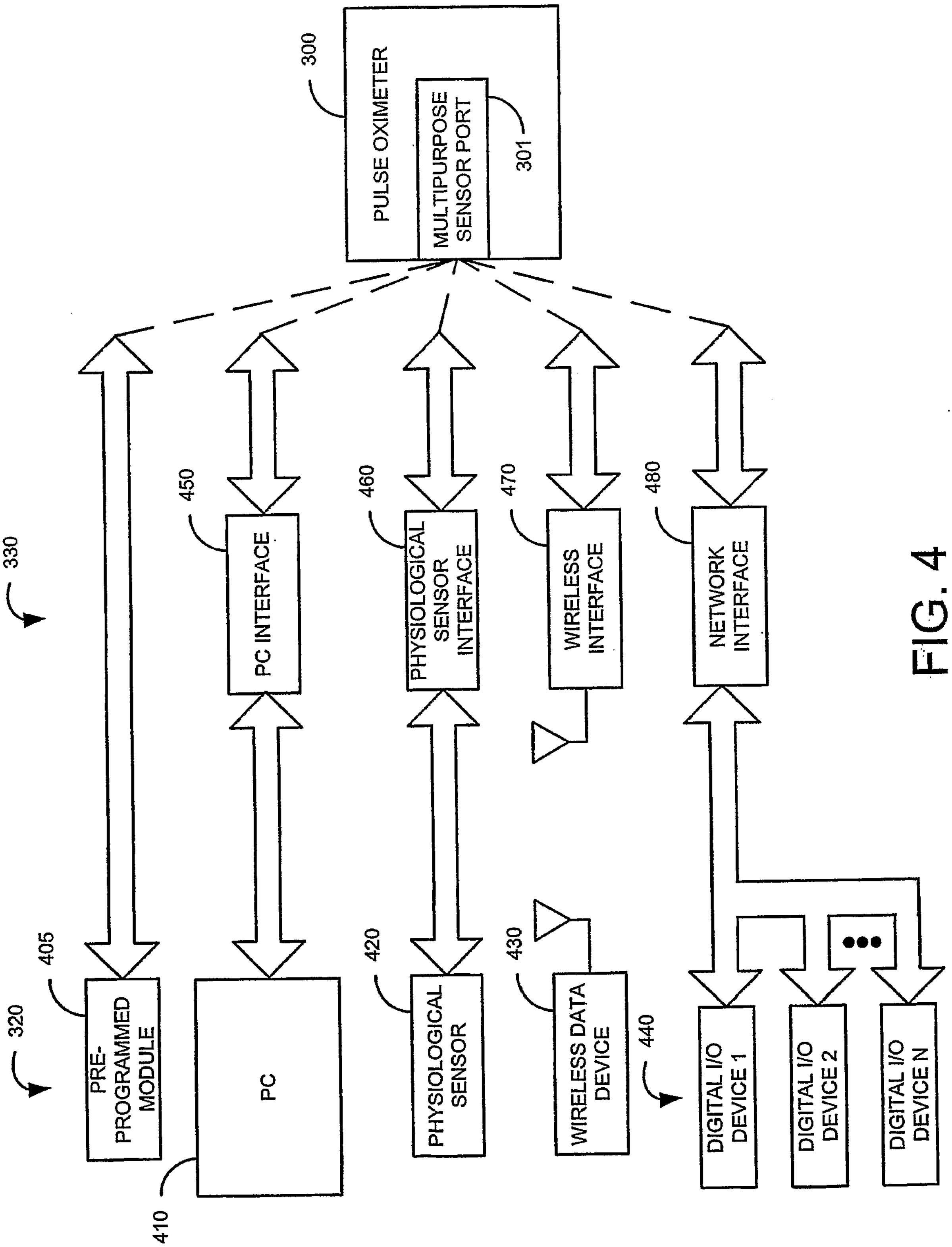

PULSE OXIMETER
300
MULTIPURPOSE SENSOR PORT
301
330
320
PRE-PROGRAMMED MODULE
405
PC INTERFACE
450
PC
410
PHYSIOLOGICAL SENSOR INTERFACE
460
PHYSIOLOGICAL SENSOR
420
WIRELESS INTERFACE
470
WIRELESS DATA DEVICE
430
NETWORK INTERFACE
480
440
DIGITAL I/O DEVICE 1
DIGITAL I/O DEVICE 2
DIGITAL I/O DEVICE N

FIG. 4

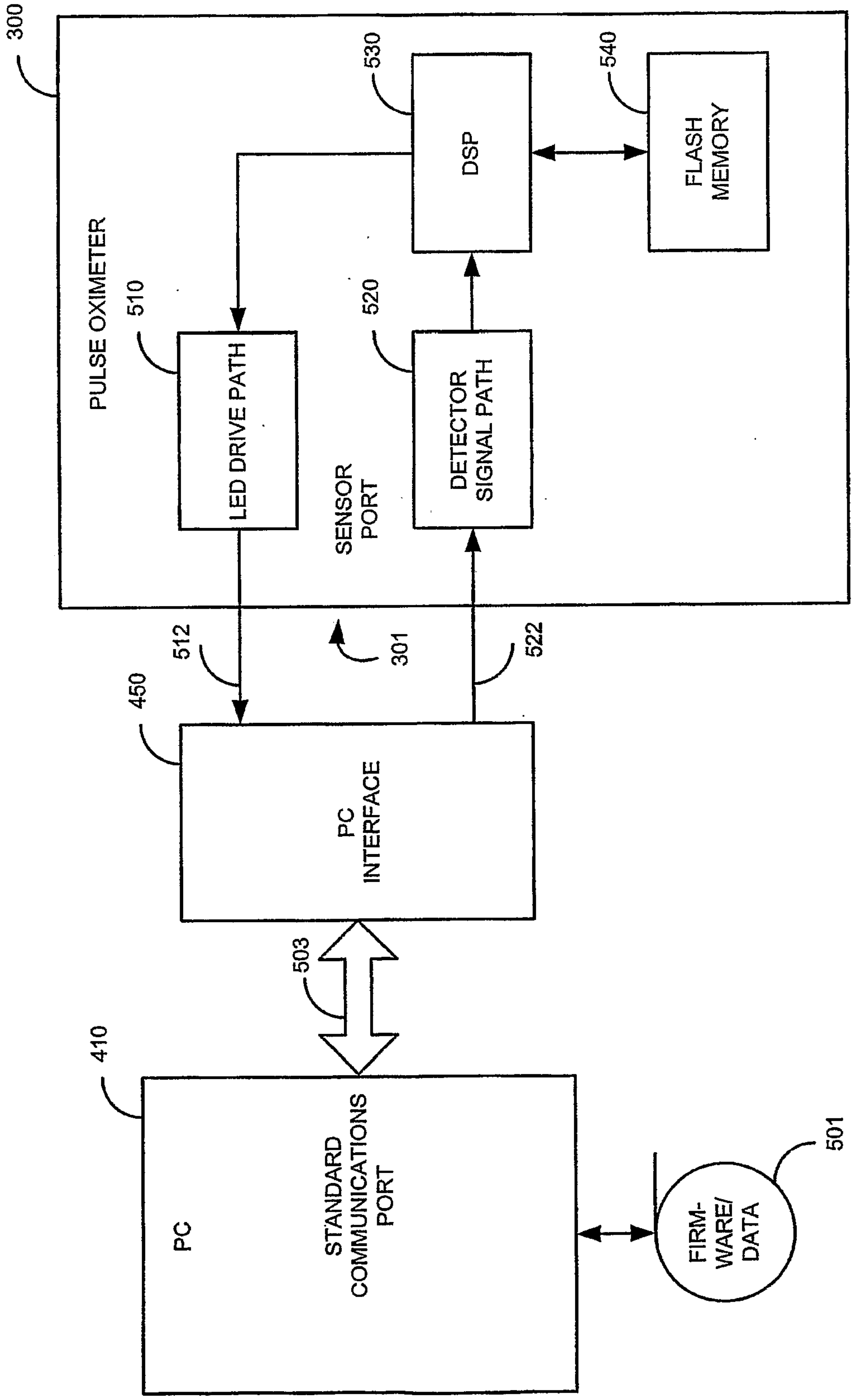

300
PULSE OXIMETER
510
LED DRIVE PATH
530
DSP
540
FLASH MEMORY
520
DETECTOR SIGNAL PATH
SENSOR PORT
512
301
522
450
PC INTERFACE
503
410
PC
STANDARD COMMUNICATIONS PORT
501
FIRM-WARE/ DATA

FIG. 5

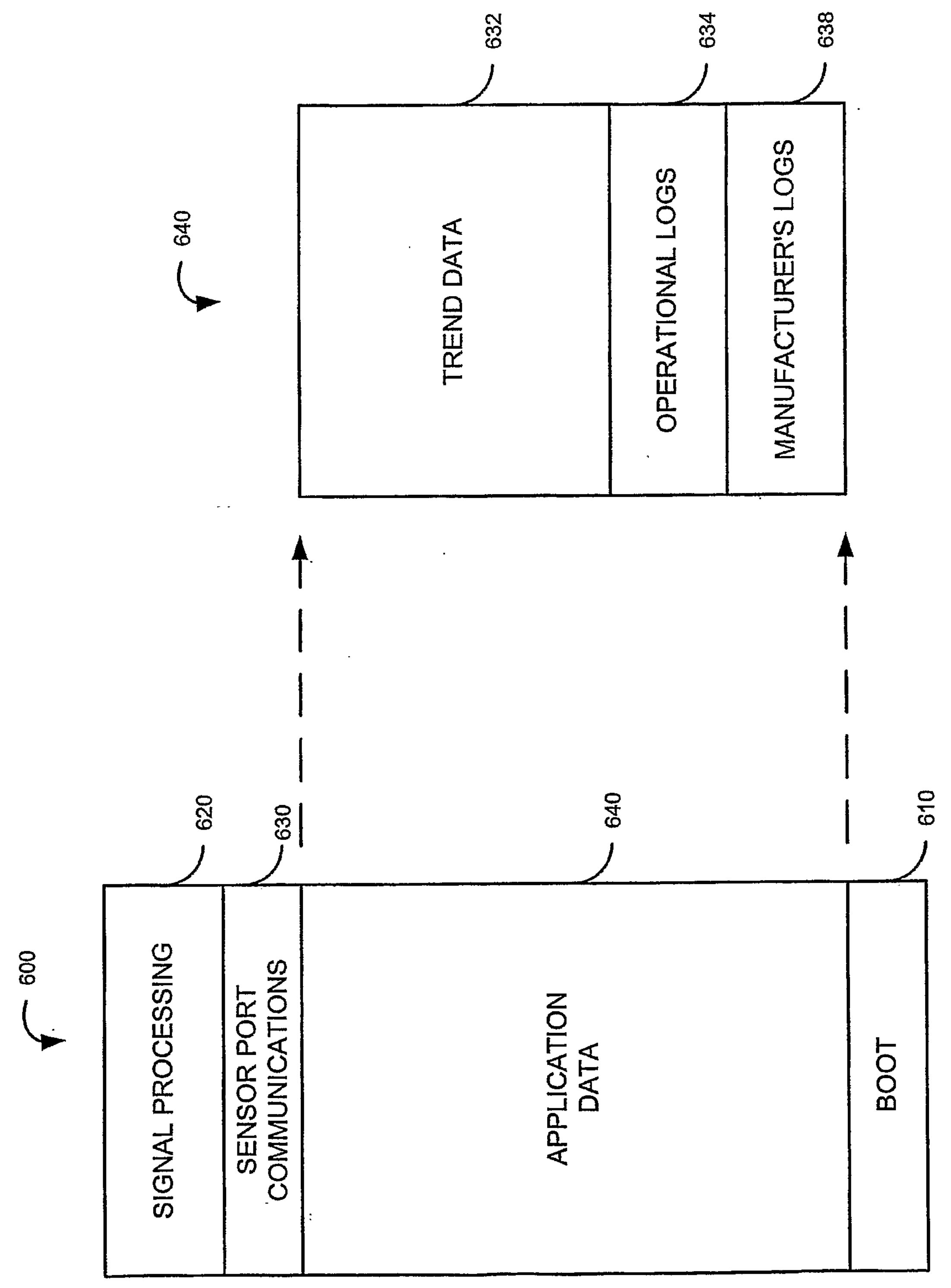
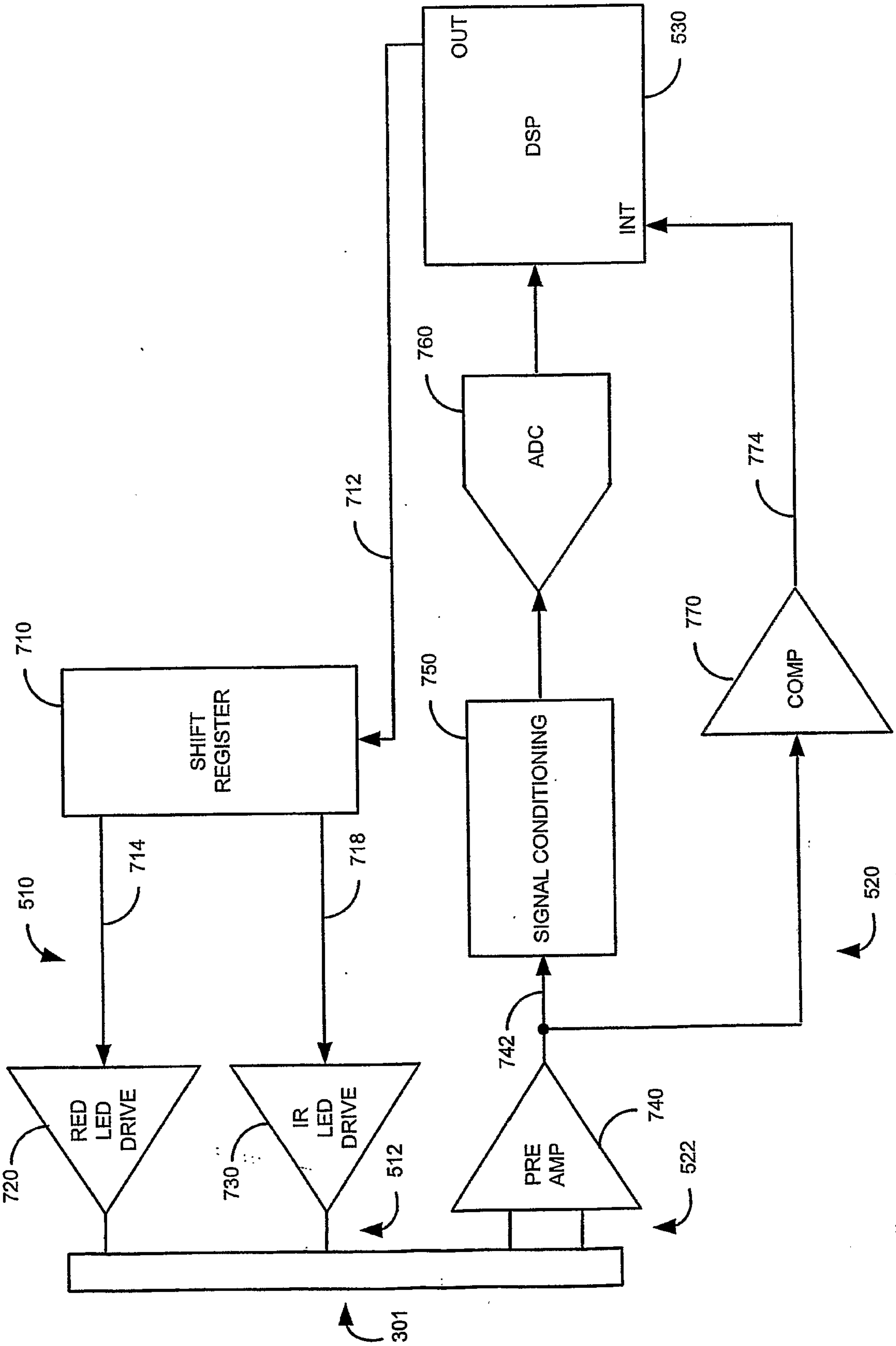

640
632
634
638
TREND DATA
OPERATIONAL LOGS
MANUFACTURER'S LOGS
600
620
630
640
610
SIGNAL PROCESSING
SENSOR PORT
COMMUNICATIONS
APPLICATION
DATA
BOOT

FIG. 6



DSP
OUT
INT
530
760
ADC
712
774
710
SHIFT REGISTER
750
SIGNAL CONDITIONING
770
COMP
510
714
718
520
742
RED LED DRIVE
IR LED DRIVE
PRE AMP
720
730
512
740
522
301

FIG. 7

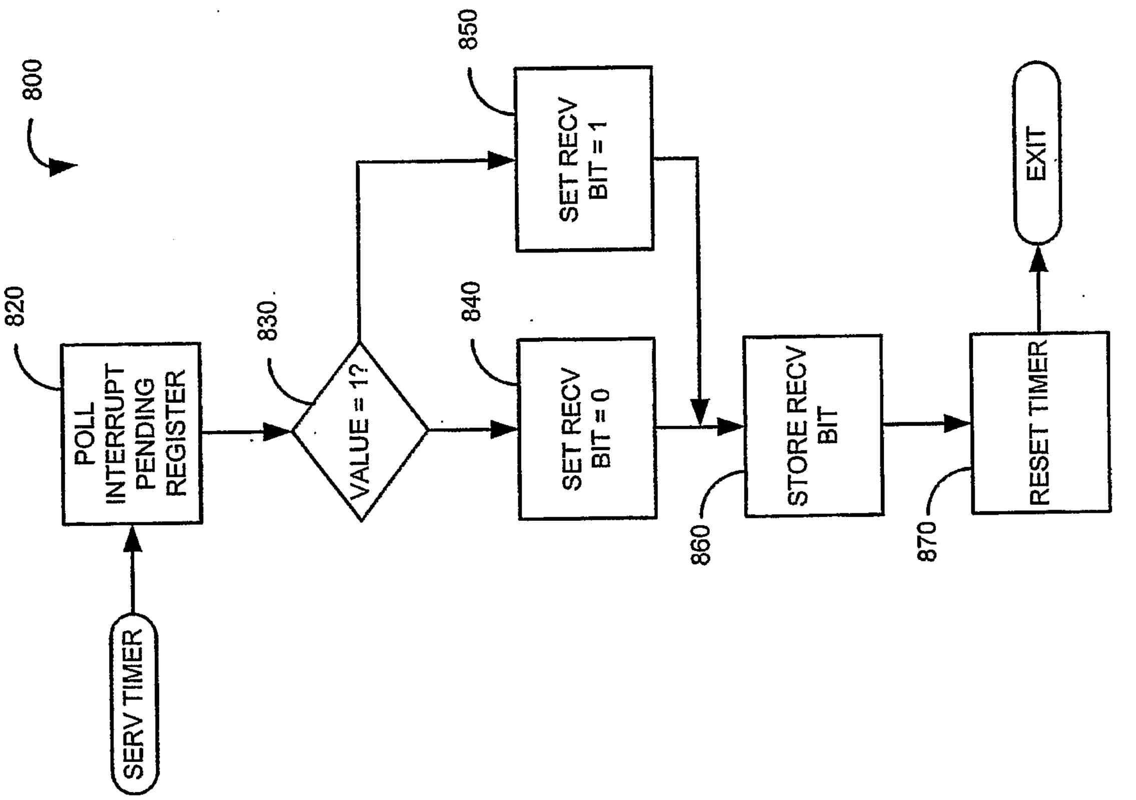

800
SERV TIMER
820
POLL INTERRUPT PENDING REGISTER
830
VALUE = 1?
840
SET RECV BIT = 0
850
SET RECV BIT = 1
860
STORE RECV BIT
870
RESET TIMER
EXIT

FIG. 8

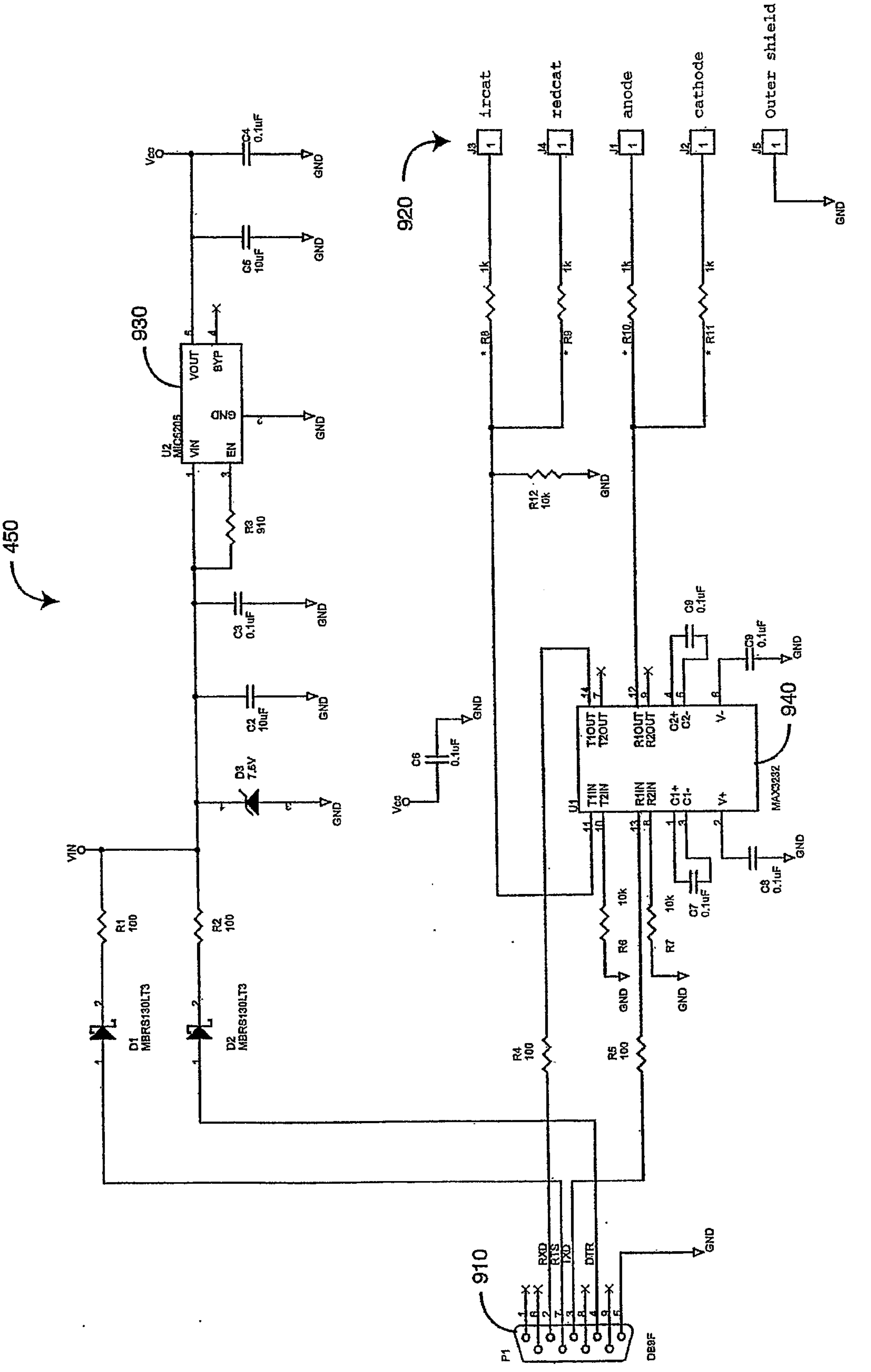

450
930
920
940
910
ircat
redcat
anode
cathode
Outer shield
U2
MIC5205
VIN
EN
VOUT
BYP
GND
U1
MAX3232
T1IN
T2IN
R1IN
R2IN
T1OUT
T2OUT
R1OUT
R2OUT
C1+
C1-
C2+
C2-
V+
V-
VIN
Vcc
D1
MBRS130LT3
D2
MBRS130LT3
D3
7.5V
R1
100
R2
100
R3
910
R4
100
R5
100
R12
10k
C2
10uF
C3
0.1uF
C4
0.1uF
C5
10uF
C6
0.1uF
C7
0.1uF
C8
0.1uF
1k
10k
J1
J2
J3
J4
J5
P1
DB9F
RXD
RTS
TXD
DTR
GND

FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6088607 A **[0003]**
- US 6236872 B **[0004]**
- US 6584336 B **[0007]**
- WO 03073927 A **[0007]**
- US 6397091 B **[0020]**
- US 351961 A **[0032]**
- US 20030218386 A **[0032]**

专利名称(译)	多功能传感器端口		
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[标]申请(专利权)人(译)	梅西莫股份有限公司		
申请(专利权)人(译)	Masimo公司		
当前申请(专利权)人(译)	Masimo公司		
[标]发明人	AL ALI AMMAR SMITH ROBERT A MCCARTHY REX J		
发明人	AL-ALI, AMMAR SMITH, ROBERT A. MCCARTHY, REX. J.		
IPC分类号	A61B5/00 A61B5/024 A61B5/1455 G06F19/00		
CPC分类号	A61B5/14552 A61B5/0002 A61B5/02416 A61B5/14551 A61B2560/045 A61B2562/08 G05B19/02 G16H40/63		
优先权	60/490091 2003-07-25 US		
其他公开文献	EP2443993A1		
外部链接	Espacenet		

摘要(译)

生理测量方法技术领域本发明涉及一种生理测量方法，包括以下步骤：提供适于激活发射器的驱动路径，以便通过具有流动血液的肉质介质传输光辐射，从而提供适于在检测器对所述光辐射后响应的信号路径。所述肉质介质衰减，所述响应指示所述流动血液的光学特性，并在所述信号路径的至少一部分上接收输入数字数据。

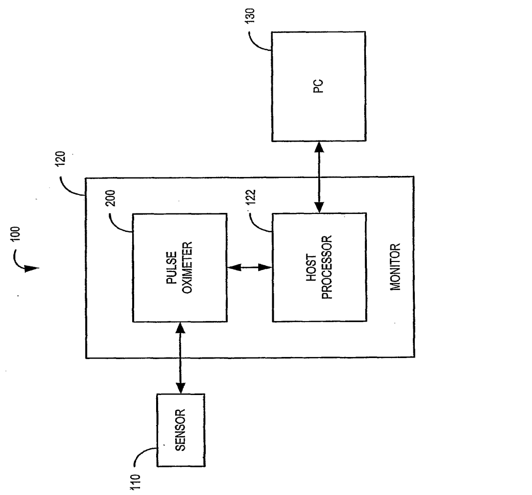

FIG. 1 (Prior Art)