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(72) **Inventeurs/Inventors:**
MA, WANRAN, US;
HANSEN, BRYAN, US

(73) **Propriétaire/Owner:**
COVIDIEN LP, US

(74) **Agent:** SMART & BIGGAR

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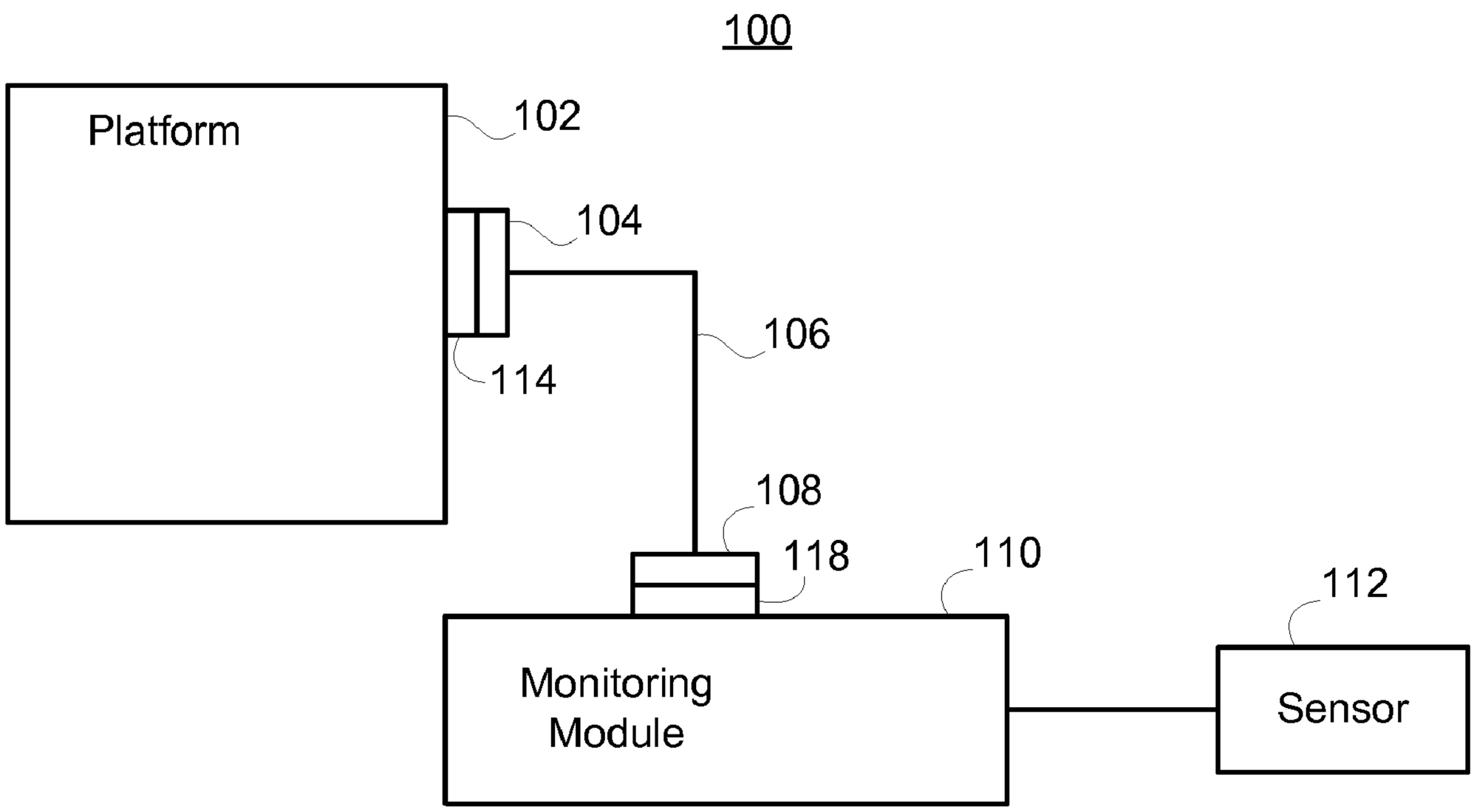
(54) **Title: PATIENT MONITORING PLATFORM INTERFACE**



(57) **Abrégé/Abstract:**
Physical monitoring systems are disclosed which may include a platform interface between a platform device and a monitoring module. The platform interface may allow physiological information from a patient such as sensor signal data, physiological trend data, other suitable data, or combinations thereof to be communicated from the monitoring module to the platform device. The platform interface may include a connector with pins configured to receive UART communications, transmit UART communications, communicate diagnostic information, be coupled to a ground, be coupled to a serial clock, receive serial data, transmit serial data, be coupled to a regulated power supply, be coupled to an unregulated power supply, communicate using USB standard, communicate using any other suitable standards, perform any other suitable functions, or any combinations thereof. The monitoring module may connect directly to the platform device, or a wired cable with suitable connectors may be used to electrically couple the monitoring module to the platform device.

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(71) Applicant *(for all designated States except US)*: **NELLCOR PURITAN BENNETT LLC** [US/US]; 6135 Gunbarrel Avenue, ATTN IP Legal, Boulder, Colorado 80301 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **MA, Wanran** [CN/US]; 3280 47th Street, Apt. 210B, Boulder, Colorado 80301 (US). **HANSEN, Bryan** [US/US]; 2519 Basil Drive, Mead, Colorado 80542 (US).

(74) Agent: **SCHAUMANN, Dave**; ATTN IP Legal, 6135 Gunbarrel Avenue, Boulder, Colorado 80301 (US).

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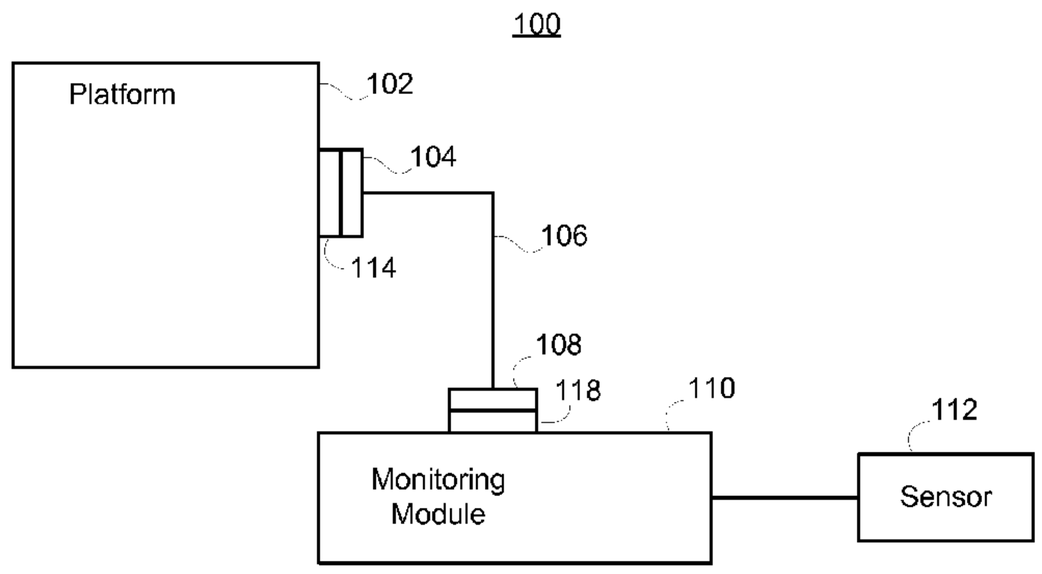

FIG. 1

(57) **Abstract**: Physical monitoring systems are disclosed which may include a platform interface between a platform device and a monitoring module. The platform interface may allow physiological information from a patient such as sensor signal data, physiological trend data, other suitable data, or combinations thereof to be communicated from the monitoring module to the platform device. The platform interface may include a connector with pins configured to receive UART communications, transmit UART communications, communicate diagnostic information, be coupled to a ground, be coupled to a serial clock, receive serial data, transmit serial data, be coupled to a regulated power supply, be coupled to an unregulated power supply, communicate using USB standard, communicate using any other suitable standards, perform any other suitable functions, or any combinations thereof. The monitoring module may connect directly to the platform device, or a wired cable with suitable connectors may be used to electrically couple the monitoring module to the platform device.

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PATIENT MONITORING PLATFORM INTERFACE

The present disclosure relates to a medical device interface, and more particularly, the present disclosure relates to an interface between a medical monitoring platform and a monitoring module.

Summary

There is described a monitoring module configured to communicate physiological information to a platform device, the monitoring module comprising: at least one connector comprising an array of 20 pins, wherein the connector is configured to connect to a corresponding connector of the platform device, the array of 20 pins comprising: at least two pins configured for receiving UART communications; at least two pins configured for transmitting UART communications; at least one pin configured for communicating diagnostic information between the monitoring module and the platform device; at least one pin configured to be coupled to a ground; at least one pin configured to be coupled to a serial clock; at least one pin configured for transmitting and receiving serial communications; at least one pin configured to be coupled to a regulated power supply; at least one pin configured to be coupled to an unregulated power supply; and at least two pins configured for standardized universal serial bus communication between the monitoring module and the platform device, wherein: the corresponding connector comprises a corresponding plurality of pins for interfacing with the array of 20 pins of the monitoring module connector.

The array of 20 pins may include at least two pins configured for receiving universal asynchronous receiver/transmitter (UART) communication, at least two pins

configured for transmitting UART communication, at least one pin configured for communicating diagnostic information (*e.g.*, whether devices are coupled, whether sufficient power has been provided), at least one pin configured to couple to a ground (*e.g.*, a ground for regulated power, unregulated power, digital data reference), at least one pin configured as a clock, at least one pin configured to receive and transmit serial communications, at least one pin configured as a regulated power supply, and at least two pins configured to a suitable universal serial bus specification.

There is also described a physiological monitoring system comprising: a monitoring module comprising a module connector comprising an array of 20 pins, wherein the array of 20 pins comprise: at least two pins configured for receiving UART communications; at least two pins configured for transmitting UART communications; at least one pin configured for communicating diagnostic information between the monitoring module and the platform device; at least one pin configured to be coupled to a ground; at least one pin configured to be coupled to a serial clock; at least one pin configured for transmitting and receiving serial communications; at least one pin configured to be coupled to a regulated power supply; at least one pin configured to be coupled to an unregulated power supply; and at least two pins configured for standardized universal serial bus communication between the monitoring module and the platform device; and a platform device comprising a platform connector, wherein the platform connector is configured to connect to the module connector, and wherein the platform connector comprises a corresponding plurality of pins for interfacing with the array of 20 pins of the monitoring module connector.

Brief Description of the Figures

The above and other features of the present disclosure, its nature and various advantages will be more apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings in which:

FIG. 1 shows an illustrative patient monitoring system including a platform device coupled to monitoring module using a wired connection, in accordance with some embodiments of the present disclosure;

FIG. 2 shows an illustrative patient monitoring system including a monitoring module coupled to a platform device using a direct connection, in accordance with some embodiments of the present disclosure;

FIG. 3 shows an illustrative first connector configured to communicatively couple to an illustrative second connector, in accordance with some embodiments of the present disclosure;

FIG. 4 shows an illustrative platform interface, in accordance with some embodiments of the present disclosure; and

FIG. 5 shows an illustrative table of detailed pin descriptions of the illustrative platform interface of **FIG. 4**, in accordance with some embodiments of the present disclosure.

Detailed Description of the Figures

The present disclosure is directed towards a connection interface between a platform device and a module device that are configured to be communicatively coupled to one another. In some embodiments, the platform device and module device may be part of a physiological monitoring system.

For example, **FIG. 1** shows an illustrative physiological monitoring system **100** in which platform device **102** is coupled to monitoring module **110** using a wired connection **106**, connectors **114** and **118**, and connectors **104** and **108** in accordance with some embodiments of the present disclosure. Wired connection **106** may include any suitable cable capable of carrying electrical signals between monitoring module **110** and platform device **102**. Wired connection **106** may include any suitable connectors for interfacing with platform device **102** and monitoring module **110**, respectively. For example, connectors **104** and **108** may be permanently affixed to wired connection **106** and may each physically engage and communicatively interface with connector **114** on platform device **102** and connector **118** on monitoring module **110**.

[0001]Platform device **102** may include any suitable hardware, software, or both for implementing a device that may be used as a platform for a physiological monitoring system. For example, platform device **102** may include a display device as well as any other suitable input/output mechanisms for receiving input from a clinician or other user of physiological monitoring system **100** and for providing output to a clinician or other user of physiological monitoring system **100**. Platform device **102** may include any suitable processing circuitry for determining physiological information from information provided by monitoring module **110**.

In some embodiments, platform device **102** may be a standalone physiological monitor such as a pulse oximeter and may be used without monitoring module **110**. In this case, platform device **102** may be directly coupled to sensors for receiving suitable physiological signals.

Monitoring module **110** may be any suitable software, hardware, or both for calculating or otherwise determining

physiological information from physiological signals received from, for example, one or more sensors **112**. Physiological information may include sensor signal data, physiological parameter data (*e.g.*, values, trends), any other suitable information, or any combination thereof. In some embodiments, monitoring module **110** may condition or otherwise process (*e.g.*, filter, sample, average, amplify, modulate, transform) a signal received from one or more sensors and communicate the conditioned signal to platform device **102**. Sensors **112** may include photoplethysmograph (PPG) sensors, respiratory sensors, electrocardiograph (EKG) sensors, electroencephalograph (EEG) sensors, electromyograph (EMG) sensors, temperature sensors, blood pressure sensors, any other suitable type of physiological sensor, or any combination thereof. Monitoring module **110** may communicate sensor signals, calculated physiological parameter values, calculated physiological parameter trend values, alarm data, message data, status data, device identification data, any other suitable information, or any combination thereof to platform device **102**. For example, monitoring module **110** may provide one or more physiological parameters to platform **102** by communicating information indicative of the physiological parameters using wired connection **106** and any suitable ports that interface wired connection **106** between platform device **102** and monitoring module **110**.

Monitoring module **110** may be configured to calculate one or more physiological parameters of a patient such as blood oxygen saturation, pulse rate, respiration rate or any other suitable respiratory activity, blood pressure (*e.g.*, systolic, diastolic, or both), blood glucose concentration, any other suitable physiological parameter, or any combination thereof. Monitoring module **110** may be configured to calculate physiological parameter trend data

such as, for example, statistical parameters (*e.g.*, an average, a moving average, standard deviation, least squares curve-fit parameters), a change (*e.g.*, a deviation, a relative difference), a rate of change (*e.g.*, a slope, a derivative), any other suitable calculated values, or any combination thereof.

In some embodiments, monitoring module **110** may be a standalone physiological monitoring device such as a pulse oximeter. In some embodiments, in order for monitoring module **110** to be functional, it must be coupled to platform device **102**. For example, platform device **102** may be configured to power monitoring module **110** using particular terminals of connectors **104** and **108**, and particular wires of wired connection **106**. In such an arrangement, monitoring module **110** may not be able to obtain power to function unless coupled to platform device **102** (although, if desired, monitoring module **110** may also be able to obtain power from other external power sources). Monitoring module **110** need not have any display interface or otherwise provide an indication of any information to a clinician or user of physiological monitoring system **100**. If desired, however, any suitable indicators or information display may be provided on monitoring module **110**. In some embodiments, monitoring module **110** may provide functionality that platform device **102** does not provide, any may be thus used to upgrade the functionality of platform device **102**.

The arrangement of platform device **102** and monitoring module **110** may be such that they are apart from one another and wired connection **106** may extend from the location of monitoring module **110** to the location of platform device **102**. Alternatively, platform device **102** and monitoring module **110** may be arranged such that they are closely spaced relative to one another and may be physically

attached to one another. For example, monitoring module **110** may latch onto platform device **102** using any suitable latching mechanism.

FIG. 2 shows an illustrative physiological monitoring system **200** in which monitoring module **208** is coupled to platform device **202** using a direct connection in accordance with some embodiments of the present disclosure. The descriptions of platform device **102** and monitoring module **110** with respect to **FIG. 1** generally apply to platform device **202** and monitoring module **208**. One of the differences between system **100** and **200** is that wired connection **106** is not used in system **200**. Rather, connector **206**, which is an input/output port of monitoring module **208**, may be coupled directly to connector **204**, which is an input/output port of platform device **202**. Monitoring module **208** may determine physiological information from physiological signals received from, for example, one or more sensors **210**. Sensors **210** may couple to monitoring module **208** using a direct connection, wired connection, wireless coupling, any other suitable coupling, or any combination thereof.

In some embodiments, monitoring module **208** may include connector **212** which is used to connect monitoring module **208** to another monitoring module (not shown but with the same or different functionality compared to monitoring module **208**) or other suitable external device, or any combination thereof.

FIG. 3 shows an illustrative connector **300** which is configured to communicatively couple to an illustrative connector **306**, in accordance with some embodiments of the present disclosure. In some embodiments, connectors **300** and **306** may be male and female connectors, respectively, and connector **300** may be plugged into connector **306** to

achieve electrical continuity among corresponding electrical terminals of the connectors.

In some embodiments, connector **300** includes electrical terminals **304** which are each electrically coupled to corresponding wires **314**. Wires **314** may include electrical insulation, which may prevent shorting or electrical contact between different wires. Wires **314** may be bundled, twisted, sheathed or otherwise arranged in a collection (*e.g.*, a ribbon cable, a sheathed 20-conductor cable). In some embodiments, wires **314** may electrically couple to an additional connector (not shown), circuitry of an electronic device (not shown), or any combination thereof. Electrical terminals **304** may be blades, tabs, sockets, pins, any other suitable type electrical terminal which may be included in a connector, or any combination thereof. Electrical terminals (e.g., electrical terminals **304**) and wires (*e.g.*, wires **314**) may be configured to transmit direct current (DC) power, alternating current (AC) power, analog signals, digital signals, any other suitable electrical activity, or any suitable combination thereof.

In some embodiments, connector **306** includes electrical terminals **310**, which may correspond to electrical terminals **304** of connector **300**. For example, connectors **300** and **306** may be connected (*e.g.*, connector **300** may be plugged into connector **306**), creating contact between electrical terminals **304** and corresponding terminals of electrical terminals **310**. Connecting connector **300** to connector **306** may include inserting male connector portion **302** into female connector portion **308** to create the contact between electrical terminals **304** and electrical terminals **310**. In some embodiments, electrical terminals **304** may be arranged on male connector portion **302**, and electrical terminals **310** may be arranged in female connector portion **308**. In some embodiments, electrical terminals **304** may be pins arranged

in a suitable array, and may correspond to electrical terminals **310** which may be holes arranged in a corresponding array. Electrical continuity among corresponding terminals may be formed by plugging the male connector into the female connector, allowing communication among devices electrically coupled to the respective connectors. Connector **300**, connector **306**, or both, may function as input/output ports for suitable devices (*e.g.*, a patient monitoring platform, a monitoring module).

In an illustrative example, connectors **300** and **306** may be a Molex 45985-0433 male connector and a Molex 46133-0203 female receptacle both manufactured by Molex of Lisle, Illinois, respectively, in which the male connector is configured to plug into the female connector. One or both connectors may be soldered or otherwise electrically coupled to a printed circuit board or other suitable circuit arrangement.

FIG. 4 shows an illustrative platform interface **400**, in accordance with some embodiments of the present disclosure. **FIG. 5** shows an illustrative table **500** of detailed pin descriptions of illustrative platform interface **400**. In some embodiments, pin arrangement **400** may include an array of 20 pins, with pin assignments as shown in table **500** of **FIG. 5**. As shown in table **500**, platform interface **400** may include one or more pins configured to provide regulated power (*e.g.*, +5 VDC), unregulated power (*e.g.*, 12-24 VDC), universal serial bus (USB) communication (*e.g.*, using USB 1.1, 2.0, 3.0 or any other suitable USB specification), diagnostics (*e.g.*, for diagnosing when a module is connected to a platform device, or when a module is sufficiently powered), universal asynchronous receiver/transmitter (UART) communication, clock (*e.g.*, inter-integrated circuit (I2C) serial clock), serial data (*e.g.*, I2C serial data), grounding, reserved

capacity for future use (*e.g.*, presently unused pins), any other suitable functionality, or any combination thereof. For example, platform interface **400** may include one or more pins for communicating with a Nell-1 OEM board.

In an illustrative example, illustrative platform interface **400** may include 20 pins as shown in **FIGS. 4-5.**

Platform interface **400** may include one or more pins for supplying regulated DC power to a monitoring module, as shown by pins 1 and 11 of **FIGS. 4-5.** Regulated power may be supplied by a potential difference between pins 1 and 11, a potential difference between either or both of pins 1 and 11 and one or more ground pins (*e.g.*, pins 8, 10, 18, 20), any other suitable set of pins, or any combination thereof. Platform interface **400** may include one or more pins for supplying unregulated DC power to a monitoring module, as shown by pins 7 and 17 of **FIGS. 4-5.** Unregulated power may be supplied by a potential difference between pins 7 and 17, a potential difference between either or both of pins 7 and 17 and one or more ground pins (*e.g.*, pins 8, 10, 18, 20), any other suitable set of pins, or any combination thereof. In some embodiments, regulated power of 5 VDC, referenced to a suitable ground, may be provided for digital communications. In some embodiments, an unregulated power supply may be provided for applications requiring more power than a regulated power supply is capable of providing or applications requiring a voltage other than 5 VDC.

Platform interface **400** may include one or more pins for transmitting power, data, or both, using a suitable USB specification (*e.g.*, USB 1.1, 2.0, 3.0). In some embodiments, two pins may be used for digital data transfer, as shown by pins 9 and 19 of **FIGS. 4-5.** In some embodiments, two pins may be used to supply bus voltage, as shown by pins 1 and 11 of **FIGS. 4-5**, and two pins may be

used to supply ground reference to the supply bus voltage, as shown by pins 10 and 20 of **FIGS. 4-5**. In some embodiments, four pins such as, for example, pins 1, 9, 19, and 20 may provide the electronic functionality of a Standard type A USB plug connector. In some embodiments, physiological information may be communicated from the monitoring module to a platform using USB data transfer pins.

Platform interface **400** may include one or more pins for communicating diagnostic information, as shown by pins 6 and 16 of **FIGS. 4-5**. Diagnostic information may include information about when a platform device has been electrically coupled to a monitoring module, whether sufficient power has been supplied to a monitoring module, whether a particular monitoring module is compatible with a platform device, any other suitable diagnostic information, or any combination thereof. In some embodiments, pin 6 of **FIGS. 4-5** may be used to communicate information about whether a monitoring module is communicatively coupled to a platform device (*e.g.*, providing an active low if communicatively coupled). In some embodiments, pin 16 of **FIGS. 4-5** may be used to communicate information about whether sufficient power has been provided for a monitoring module (*e.g.*, providing an active high when the power is sufficient). Diagnostic information may include message data (*e.g.*, periodic updates), alarm data (*e.g.*, insufficient power, malfunction), warning data (*e.g.*, poor power quality), status data (*e.g.*, monitoring module completely connected to platform, periodic systems check results), any other suitable data, or any combination thereof.

Platform interface **400** may include one or more grounding pins, as shown by pins 8, 10, 18, and 20 of **FIGS. 4-5**. Grounding pins may be used a reference for a

regulated power supply, an unregulated power supply, digital data communication, analog data communication, a digital clock, any other suitable electronic activity, or any combination thereof.

Platform interface **400** may include one or more pins configured for communicating using the I2C interface, as shown by pins 2 and 12 of **FIGS. 4-5**. The I2C interface may include a serial data line (SDA) as shown by pin 12 and a serial clock (SCL) as shown by pin 2, which may each use a regulated power supply (*e.g.*, 5 VDC as shown by pins 1 and 11), along with a suitable ground as shown by pins 10 and 20. The SDA line may allow digital communications to be received, transmitted, or both.

Platform interface **400** may include one or more pins configured to receive UART communications, as shown by pins 14 and 15 of **FIGS. 4-5**. Platform interface **400** may include one or more pins configured to transmit UART communications, as shown by pins 4 and 5 of **FIGS. 4-5**. Any suitable UART may be used in accordance with the present disclosure such as, for example, models 8250, 16450, 16550, and 16950 manufactured by National Semiconductor of Santa Clara, California. A UART may include a clock generator, a shift register (*e.g.*, for sending or receiving data), transmit/receive control, read-write control logic, first-in first-out (FIFO) buffer memory for queue processing, any other suitable components, or any combination thereof. In some embodiments, a UART may be a standalone integrated circuit. In some embodiments, a UART may be included in a microcontroller (*e.g.*, a Nell-1 OEM board), integrated circuit, chip, or other suitable electronic assembly. In some embodiments, a UART may be configured to communicate synchronously so that timing (*e.g.*, start, stop) bits are not used in the data stream. In some embodiments, physiological information may be communicated from the

monitoring module to a platform using pins configured for UART communications. In some embodiments, platform interface **400** may be configured to receive, transmit, or both, communications for more than one UART, as shown by the designations UART1 (first UART) and UART2 (second UART) of pins 4, 5, 14, and 15 in **FIG. 5**.

Platform interface **400** may include one or more pins which are not configured, capable of being configured as desired, reserved for future use, or otherwise not functionally assigned, as shown by pins 3 and 13 of **FIGS. 4-5**. In some embodiments, pins 3 and 13 may be used to provide additional power (regulated or unregulated), provide additional digital communications capacity, provide analog communications capacity, provide additional diagnostics, provide device identification information, any other suitable configuration relative to that shown in **FIGS. 4-5**, or any combination thereof. In some embodiments, pins 3 and 13 need not be electrically coupled to any circuitry of a monitoring module or platform device.

Although illustratively shown as having 20 pins, platform interface **400** may include any suitable number of pins, arranged in any suitable array which may be, but need not be, patterned. Pins may be arranged in any suitable order according to functionality, polarity, signal type, power level, any other suitable designation, or any combination thereof. Although discusses as "pins", the terminals of platform interface may include any suitable geometry such as, for example, tabs, blades, holes, sockets, any other suitable electrical terminal type, or any combination thereof. In some embodiments, a platform interface may include pins configured according to standards such as, for example, IEEE 1394, parallel small computer system interface (SCSI), serial data interface at 1200 Baud (SDI-12), recommended standard 422 (RS-422), any

other suitable standards for data communication, or any combination thereof.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A monitoring module configured to communicate physiological information to a platform device, the monitoring module comprising:

at least one connector comprising an array of 20 pins, wherein the connector is configured to connect to a corresponding connector of the platform device, the array of 20 pins comprising:

at least two pins configured for receiving UART communications;

at least two pins configured for transmitting UART communications;

at least one pin configured for communicating diagnostic information between the monitoring module and the platform device;

at least one pin configured to be coupled to a ground;

at least one pin configured to be coupled to a serial clock;

at least one pin configured for transmitting and receiving serial communications;

at least one pin configured to be coupled to a regulated power supply;

at least one pin configured to be coupled to an unregulated power supply; and

at least two pins configured for standardized universal serial bus communication between the monitoring module and the platform device, wherein:

the corresponding connector comprises a corresponding plurality of pins for interfacing with the array of 20 pins of the monitoring module connector.

2. The monitoring module of claim 1, wherein the monitoring module further comprises an interface configured to communicatively couple to at least one sensor.

3. The monitoring module of claim 1 or 2 further comprising processing circuitry configured to:

process physiological information; and

communicate physiological information to the platform device at a time when the connector is coupled to the corresponding connector of the platform device.

4. The monitoring module of claim 3, wherein the physiological information is provided by the monitoring module to the platform device using at least one of the pins of the array of 20 pins.

5. The monitoring module of claim 3 or 4, wherein the physiological information is communicated by the monitoring module to the platform device using the at least two pins configured for transmitting UART communications.

6. The monitoring module of claim 3 or 4, wherein the physiological information is communicated by the monitoring module to the platform device using the at least two pins configured for standardized universal serial bus communication.

7. The monitoring module of claim 3 or 4, wherein the physiological information is at least one of sensor signal data, physiological parameter trend data, alarm data, message data, monitoring module identification information, and sensor identification.

8. The monitoring module of any one of claims 1 to 7, wherein the connector is further configured to connect to a wired cable, wherein the wired cable includes a first connector and a second connector arranged at opposite ends of the wired cable, and wherein the first connector is configured to connect to the connector of the monitoring module, and wherein the second connector is configured to connect to the corresponding connector of the platform device.

9. The monitoring module of any one of claims 1 to 7, wherein the corresponding plurality of pins of the corresponding connector of the platform device are configured to mate with the array of 20 pins of the connector of the monitoring module.

10. A physiological monitoring system comprising:

a monitoring module comprising a module connector comprising an array of 20 pins, wherein the array of 20 pins comprise:

at least two pins configured for receiving UART communications;

at least two pins configured for transmitting UART communications;

at least one pin configured for communicating diagnostic information between the monitoring module and the platform device;

at least one pin configured to be coupled to a ground;

at least one pin configured to be coupled to a serial clock;

at least one pin configured for transmitting and receiving serial communications;

at least one pin configured to be coupled to a regulated power supply;

at least one pin configured to be coupled to an unregulated power supply; and

at least two pins configured for standardized universal serial bus communication between the monitoring module and the platform device; and

a platform device comprising a platform connector, wherein the platform connector is configured to connect to the module connector, and wherein the platform connector comprises a corresponding plurality of pins for interfacing with the array of 20 pins of the monitoring module connector.

11. The physiological monitoring system of claim 10, wherein the monitoring module further comprises an interface configured to communicatively couple to at least one sensor.

12. The physiological monitoring system of claim 10 or 11, wherein the monitoring module further comprises processing circuitry configured to:

process physiological information; and

communicate physiological information to the platform device at a time when the module connector is coupled to the platform connector.

13. The physiological monitoring system of claim 12, wherein the physiological information is provided by the monitoring module to the platform device using at least one of the pins of the array of 20 pins.

14. The physiological monitoring system of claim 12 or 13, wherein the physiological information is communicated by the monitoring module to the platform device using the at least two pins configured for transmitting UART communications.

15. The physiological monitoring system of claim 12 or 13, wherein the physiological information is communicated by the monitoring module to the platform device using the at least two pins configured for standardized universal serial bus communication.

16. The physiological monitoring system of claim 12 or 13, wherein the physiological information is at least one of sensor signal data, physiological parameter trend data, alarm data, message data, monitoring module identification information, and sensor identification.

17. The physiological monitoring system of any one of claims 10 to 16, wherein the module connector is further configured to connect to a wired cable, wherein the wired cable includes a first connector and a second connector arranged at opposite ends of the wired cable, and wherein the first connector is

configured to connect to the module connector, and wherein the second connector is configured to connect to the platform connector.

18. The physiological monitoring system of any one of claims 10 to 16, wherein the monitoring module is a first monitoring module, and wherein the module connector is a first connector, the first monitoring module further comprising:

a second connector configured to couple to a second monitoring module, the second connector comprising a plurality of pins, the plurality of pins of the second connector comprising:

at least two pins configured for receiving UART communications;

at least two pins configured for transmitting UART communications;

at least one pin configured for communicating diagnostic information between the first monitoring module and the second monitoring module;

at least one pin configured to be coupled to a ground;

at least one pin configured to be coupled to a serial clock;

at least one pin configured for transmitting and receiving serial communications;

at least one pin configured to be coupled to a regulated power supply;

at least one pin configured to be coupled to an unregulated power supply; and

at least two pins configured for standardized universal serial bus communication between the second monitoring module and the first monitoring module.

5

20

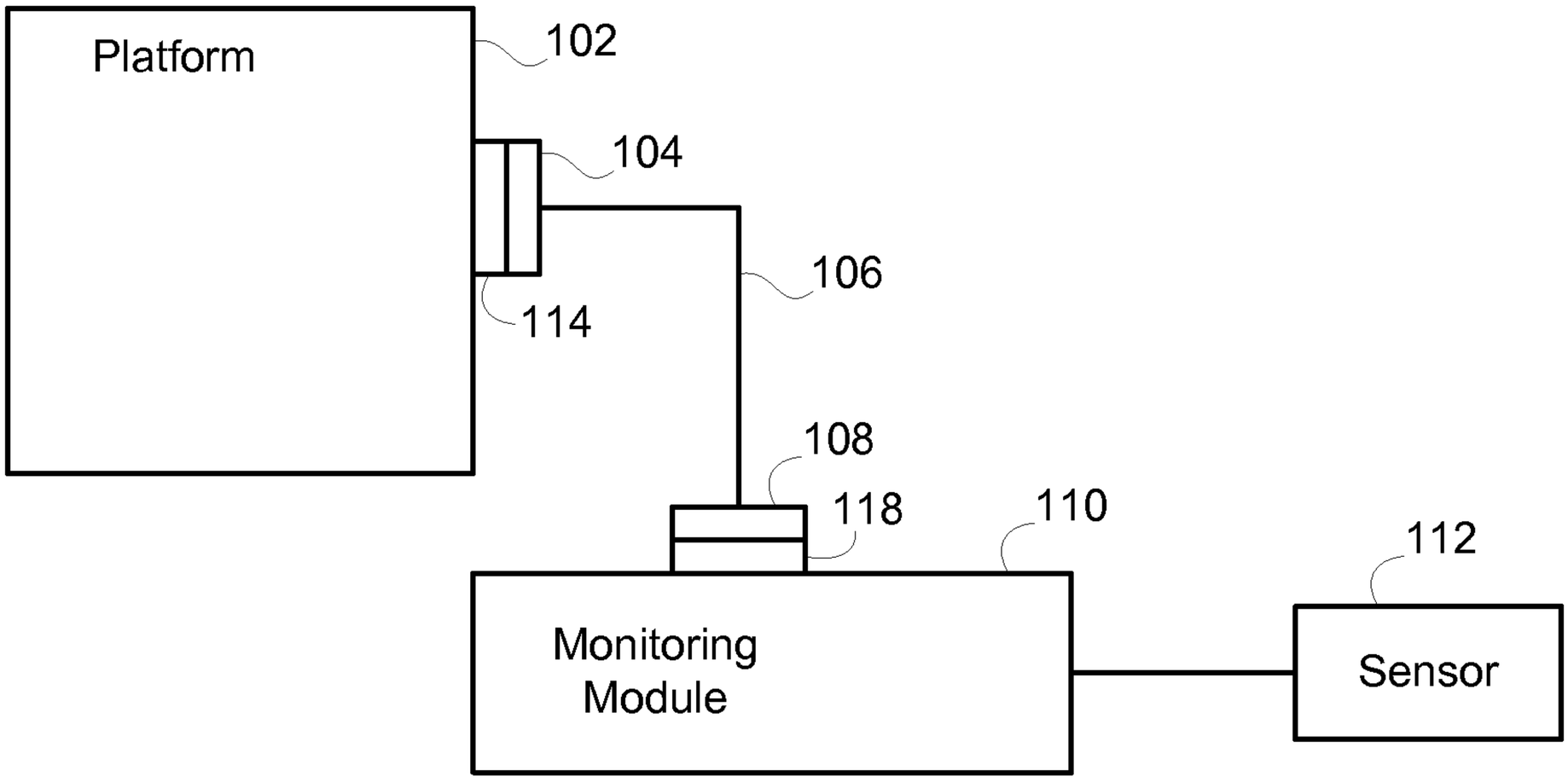

100
Platform
102
104
106
114
108
118
110
112
Monitoring Module
Sensor

FIG. 1

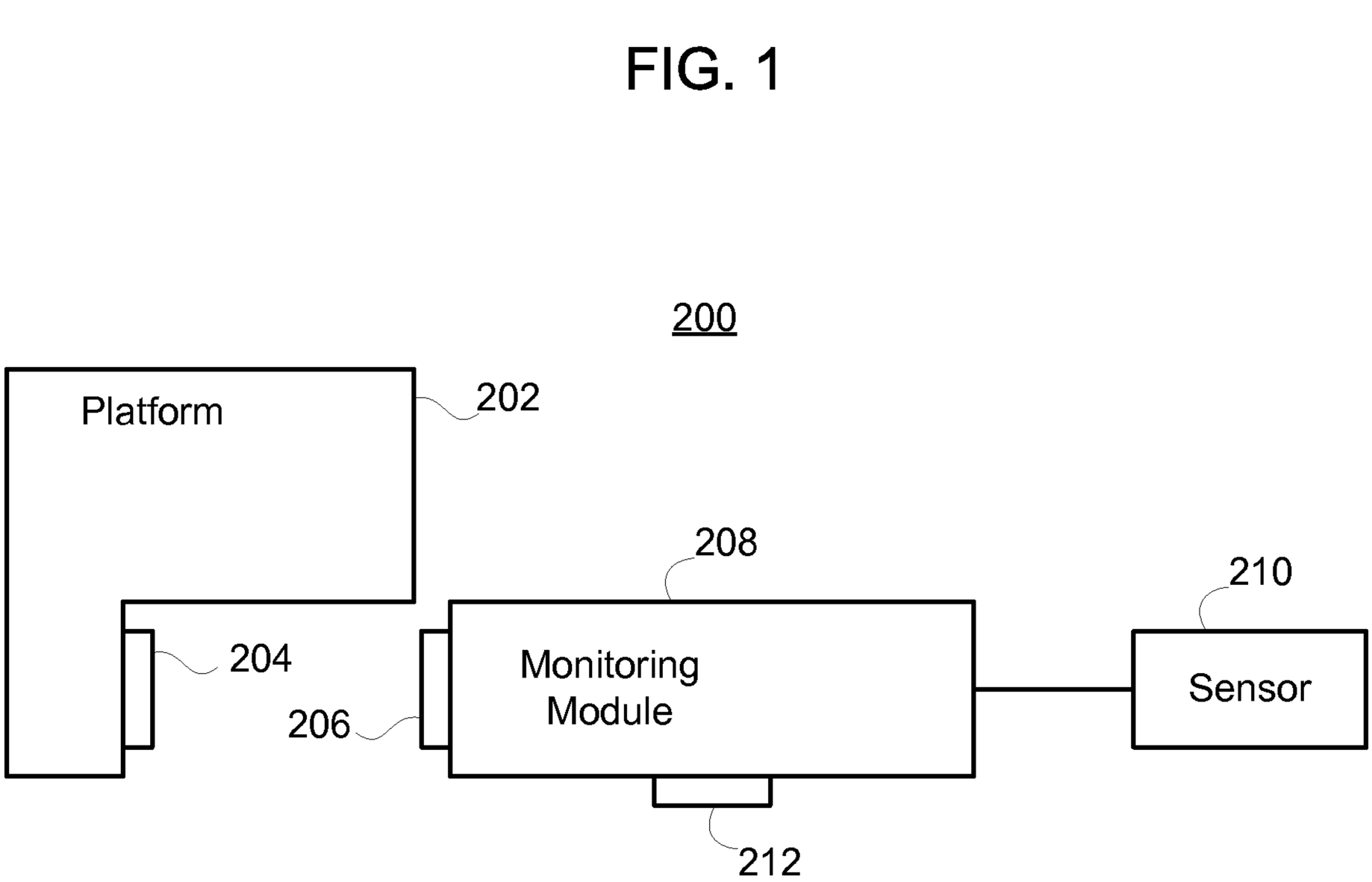

200
Platform
202
208
210
204
206
Monitoring Module
Sensor
212

FIG. 2

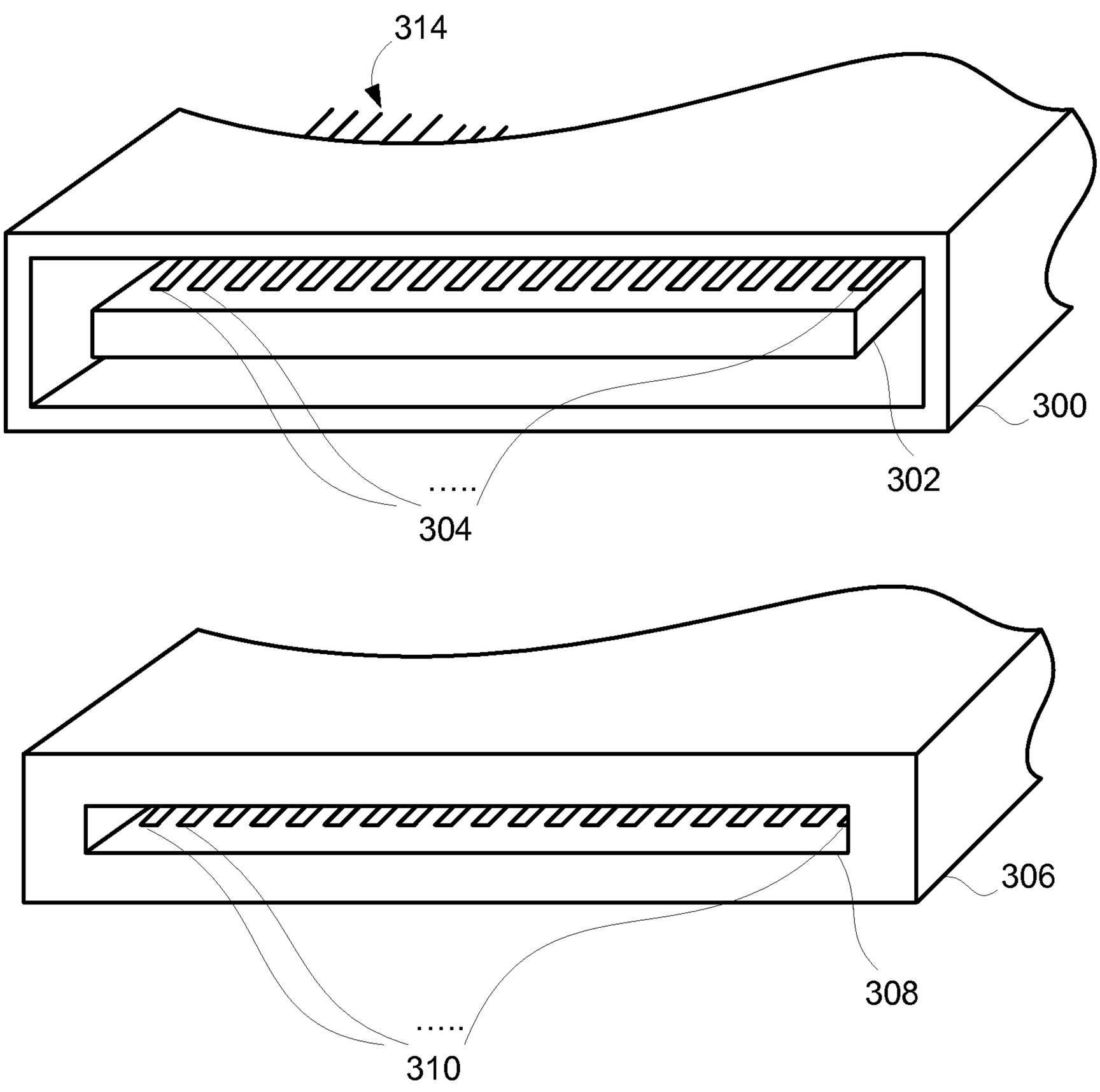


FIG. 3

400

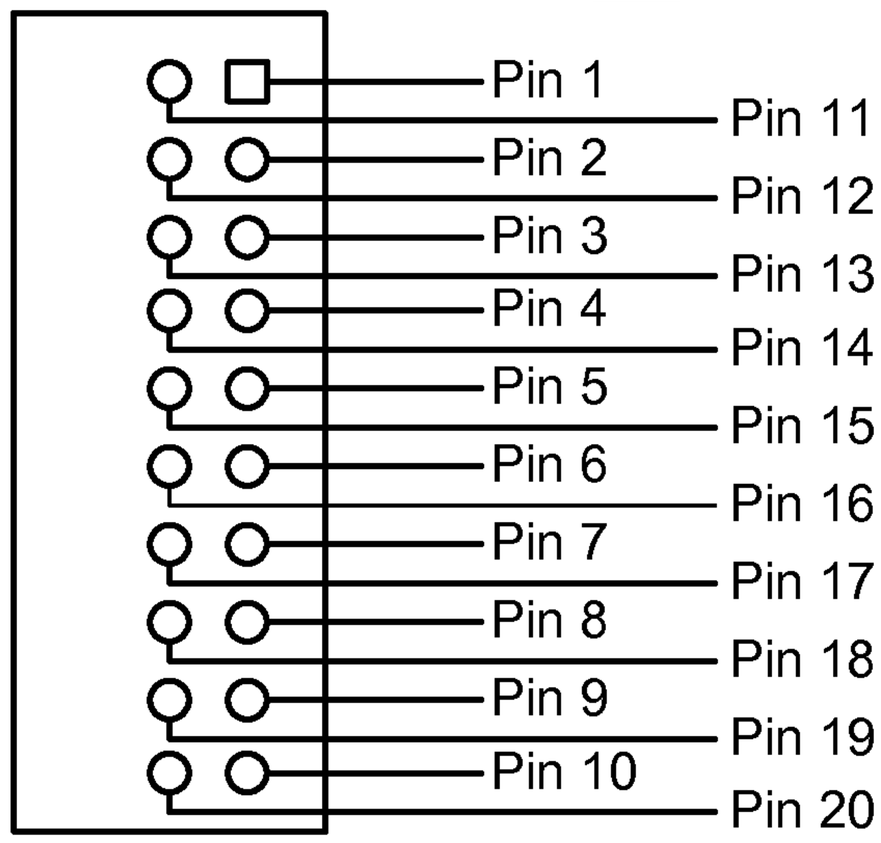
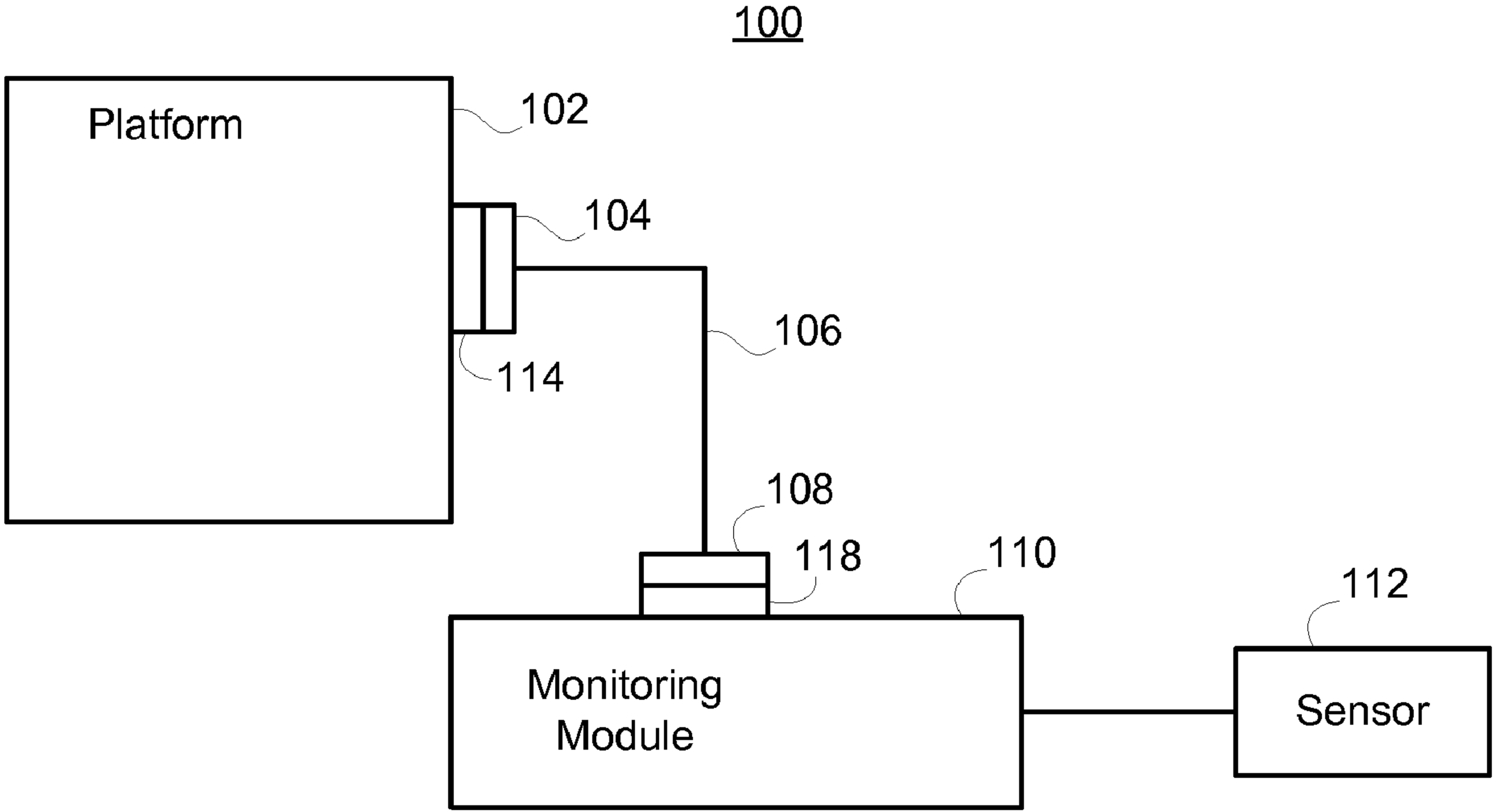


FIG. 4

500

Pin	Name	Description
1	Regulated Power	+5 VDC
2	SCL	I2C Serial Clock
3	Reserved	Reserved
4	Nell_TX	UART1 Transmit
5	UART2_TX	UART2 Transmit
6	Module_Pret	Digital output; active low when module is connected
7	Unregulated Power	12-24 VDC
8	GND	Ground
9	USB_N	USB Negative
10	GND	Ground
11	Regulated Power	+5 VDC
12	SDA	I2C Serial Data
13	Reserved	Reserved
14	Nell_RX	UART1 Receive
15	UART2_RX	UART2 Receive
16	PWRGD	Digital output; active high when module power is OK
17	Unregulated Power	12-24 VDC
18	GND	Ground
19	USB_P	USB Positive
20	GND	Ground

FIG. 5


100
Platform
102
104
106
114
108
118
110
112
Monitoring
Module
Sensor