Knobbe Martens
INTELLECTUAL PROPERTY + TECHNOLOGY LAW

Patent Owner Masimo Corporation's Demonstratives For Trial Hearing

August 26, 2021

Sotera Wireless, Inc. v. Masimo Corporation
IPR2020-00912 (Patent 10,213,108 B2)
IPR2020-00954 (Patent 9,788,735 B2)
IPR2020-01015 (Patent 9,795,300 B2)
IPR2020-01054 (Patent 9,872,623 B2)

OVERVIEW

Overview

- Introduction
  - Masimo's Patents
  - Claimed Features
  - Level of Ordinary Skill/Priority Date
- Claim Construction
- Akai-Based Grounds in '108 IPR
- Goldberg-Based Grounds Common to All IPRs
  - Issues specific to certain IPRs
- Money-Based Grounds Common to All IPRs
  - Issues specific to certain IPRs

Conventional Patient Monitoring

- Conventional patient monitoring systems require a patient to be tethered to a nearby monitor
- Requires wires for separate sensors for each monitored parameter
  - SpO_2 (blood oxygen saturation)
  - Blood pressure
  - EKG, etc.
- Patient relocation leads to awkward movement of equipment and cables, or disconnection of sensors from monitor

See, e.g., 108 IPR POPR 3-6

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Claimed Solution

- The ’108, ’735, ’300, and ’623 Patents address the challenge of providing hospital grade portable patient monitoring.
  - *See, e.g.,* ’108 Patent at 2:25-35.
- Claimed solution:
  - Arm/wrist wearable portable patient monitor
  - Multiple sensor ports for connecting multiple sensors, including pulse oximetry sensor
  - Strap for mounting the monitor to patient’s arm/wrist
  - Wireless transmitter for transmitting information to separate monitoring device

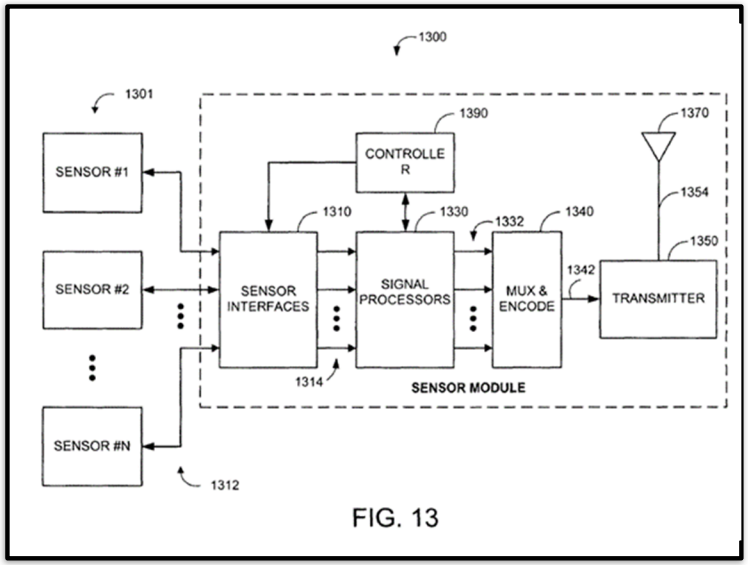

FIG. 13

— ’108 Patent at Figs. 3, 13

See, e.g., ’108 IPR POPR 3-6

Patent Overview

IPR Proceeding	Patent No.	Title	Claims
IPR2020-00912 ("'108 IPR")	10,213,108	ARM MOUNTABLE PORTABLE PATIENT MONITOR	Total: 22 Independent: 1, 17, 19, 21
IPR2020-00954 ("'735 IPR")	9,788,735	BODY WORN MOBILE MEDICAL PATIENT MONITOR	Total: 20 Independent: 1, 13, 20
IPR2020-01015 ("'300 IPR")	9,795,300	WEARABLE PORTABLE PATIENT MONITOR	Total: 20 Independent: 1, 16
IPR2020-01054 ("'623 IPR")	9,872,623	ARM MOUNTABLE PORTABLE PATIENT MONITOR	Total: 20 Independent: 1, 17, 20

Common Features Across Independent Claims

- Portable patient monitoring device
- Arm/wrist wearable housing/case
  - All claims other than Claim 16 of ’300 Patent
- Strap mounted to back side of housing
  - All claims other than Claims 1 and 16 of ’300 Patent
- Multiple (typically 3) sensor ports to receive signals from sensors
- Wirelessly transmit information from the portable patient monitoring device to a separate or remote computing/monitoring device

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Additional Claim Features

- Sensor port to “electrically receive” or “electrically convey” a signal from a pulse oximetry sensor
  - ’108 Patent: All claims
  - ’735 Patent: Claim 20
  - ’623 Patent: All claims
- Signals from the pulse oximetry sensor are analog and signals from another sensor are digital (analog/digital signal configuration limitations)
  - ’108 Patent: Claims 19, 21
  - ’735 Patent: Claim 1, 13, 20 (Claim 13 does not specify analog signal from an SpO_2 sensor)
  - ’300 Patent: All claims require analog and digital signals, but do not specify that the analog signal comes from the SpO_2 sensor
- First sensor is a pulse oximetry sensor
  - All claims except Claims 1 and 16 of ’300 Patent
- One sensor is a blood pressure sensor
  - ’735 Patent: Claim 20
  - ’623 Patent: Claims 1, 20

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Undisputed Level of Ordinary Skill and Priority Date

"[A] person with at least a B.S. degree in electrical or biomedical engineering or a related field with at least two years' experience designing patient monitoring systems."

— '108 IPR Institution Decision 20.

Priority date for '108, '735, '300, and '623 Patents is March 25, 2002.

— '108 IPR Pet. 13.

CLAIM CONSTRUCTION

Claim Construction – Parties' Proposals

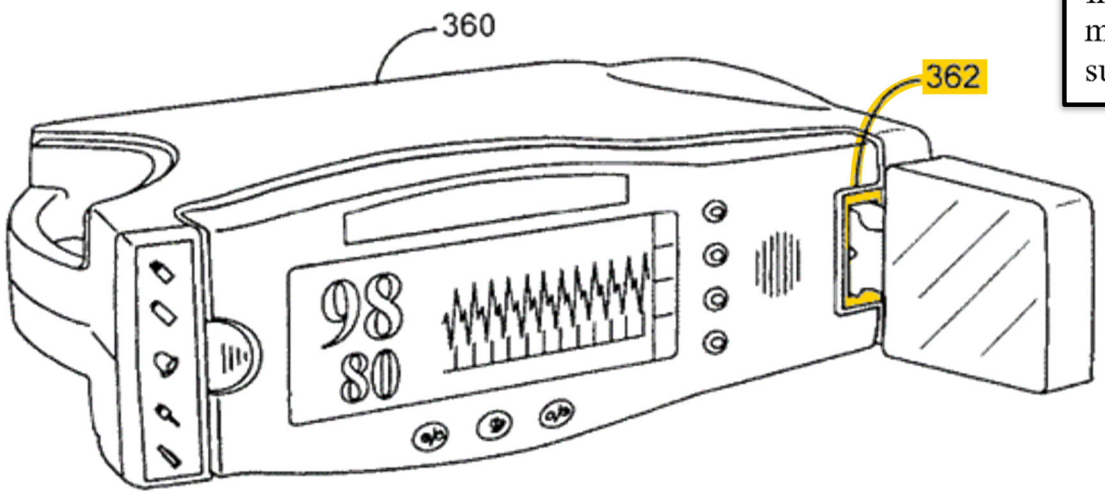
"Sensor Port" or "Sensor Communication Port"

Masimo's Proposed Construction	Sotera's Proposed Construction
"connector that mates with a compatible connector from a sensor"	Petition: No construction provided. Reply: "a ***permanent*** or removable input/output interface for a sensor"

See, e.g., '108 IPR Pet. 15; '108 IPR POR 17; '108 IPR Reply 5; '735 IPR Pet. 14-15; '735 IPR POR 15; '735 IPR Reply 5

Specification Uses Plain and Ordinary Meaning

- No express definition of "sensor port" in the patents or prosecution histories.
- Patents use the term consistent with plain and ordinary meaning

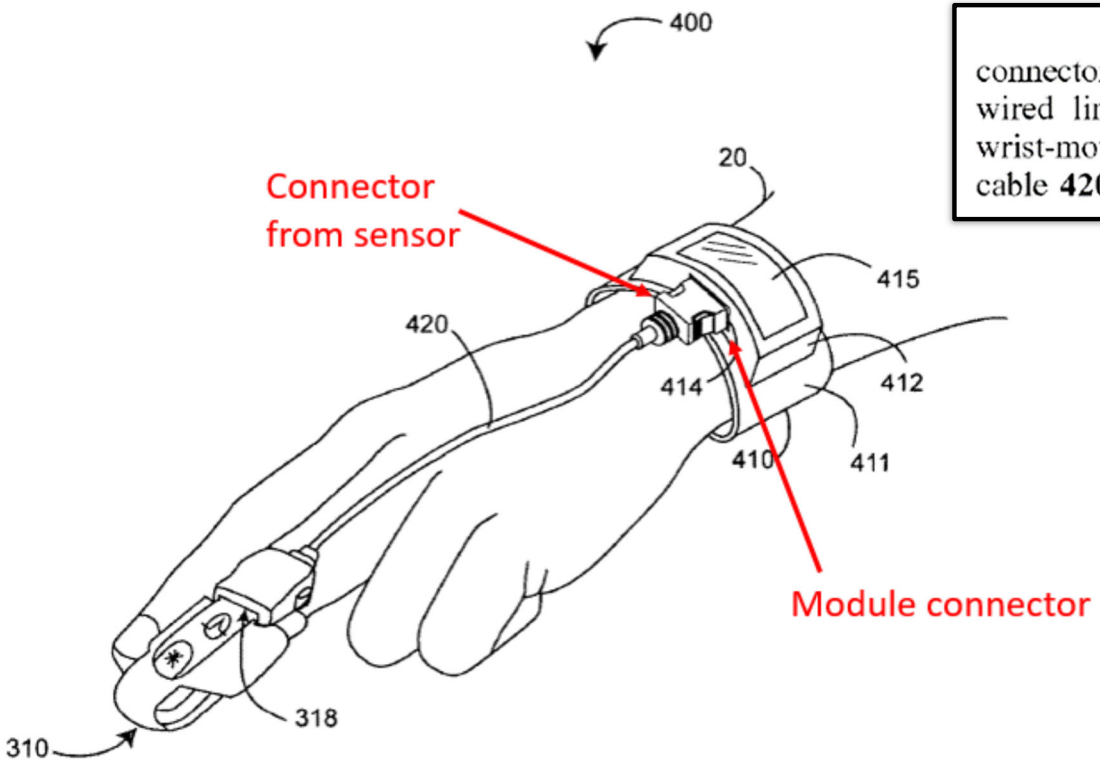


> As shown in FIG. **3**, the monitor module **500** is advantageously plug-compatible with a conventional monitor **360**. In particular, the monitor's sensor port **362** connects to the monitor module **500** in a similar manner as to a patient cable, such as a pulse oximetry patient cable **140** (FIG. **1**).

— '108 Patent at 4:65-5:2

See, e.g., '108 IPR POR 17-18

Specification Illustrates a Sensor Port as a "Connector"



> The auxiliary cable **420** mates to a sensor connector **318** and a module connector **414**, providing a wired link between a conventional sensor **310** and the wrist-mounted module **410**. Alternatively, the auxiliary cable **420** is directly wired to the sensor module **400**.

— '108 Patent at 5:33-37, FIG. 4A

See, e.g., '108 IPR POR 17-18

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Hardwired Connection Is Not a Sensor Port Connection

Patents distinguish a port from a hardwired or direct connection

> The auxiliary cable **420** mates to a sensor connector **318** and a module connector **414**, providing a wired link between a conventional sensor **310** and the wrist-mounted module **410**. Alternatively, the auxiliary cable **420** is directly wired to the sensor module **400**.

— '108 Patent at 5:33-37

See, e.g., '108 IPR POR 19

Dictionary Definitions of "Port"

Contemporaneous dictionaries also support Masimo's construction.

port[1] *n.* **1.** An interface through which data is transferred between a computer and other devices (such as a printer, mouse, keyboard, or monitor), a network, or a direct connection to another computer. The port appears to the CPU as one or more memory addresses that it can use to send or receive data. Specialized hardware, such as in an add-on circuit board, places data from the device in the memory addresses and sends data from the memory addresses to the device. Ports may also be dedicated solely to input or to output. Ports typically accept a particular type of plug used for a specific purpose. For example, a serial data port, a keyboard, and a high-speed network port all use different connectors, so it's not possible to plug a cable into the wrong port. *Also called:* input/output port.

— Microsoft Computer Dictionary (5th ed. 2002) (EX2021)

port[1] (pôrt, pōrt) *n.* [ME < OE < Lat. *portus.*] **1. a.** A town or city having a harbor for ships taking on or discharging cargo. **b.** A place on a waterway that provides a harbor for a nearby city. **c.** The harbor or waterfront district of a city. **2.** A place of shelter or anchorage : HAVEN. **3.** A port of entry. **4.** *Computer Sci.* **a.** An entrance to or exit for a data network. **b.** A connection point for a peripheral device.

— Webster's II New College Dictionary (2001) (EX2020)

port[5] (pôrt) ***n.*** [ME < OFr *porte* < L *porta*, door, akin to *portus:* see PORT[1]] **1** [Now Scot.] a portal; gateway, esp. to a town or city **2** *a)* PORTHOLE *b)* a porthole covering **3** an opening, as in a cylinder face or valve face, for the passage of steam, gas, water, etc. **4** *a) Electronics* a place at which energy or signals enter or leave a device, circuit, etc. *b) Comput.* the circuit, outlet, etc. which serves as a connection between a computer and its peripheral

— Webster's New World College Dictionary (4th ed. 2001) (EX2019)

See, e.g., '108 IPR POR 19

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Sotera's Criticisms

Sotera criticizes Masimo's construction:

1. *Masimo's construction is not a special meaning.*
2. *Masimo's expert "added three new 'port' requirements during his deposition"*
3. *Masimo's construction is broad enough to include a hardwired connection*
4. *Masimo's construction lacks data input/output*

See, e.g., '108 IPR Reply 1-5

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Institution decisions specifically asked the parties to construe "sensor port" or "sensor communication port"

> We do note, however, that the claims require a first, second, and third "sensor port." *See, e.g.*, Ex. 1001, claim 1. To the extent the parties contend that the term "sensor port" has any special meaning or otherwise should be construed, the parties should clearly identify what they contend the scope of a "sensor port" encompasses.

— '108 IPR Institution Decision 22

See, e.g., '108 IPR Sur-Reply 3-4

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See, e.g., '108 IPR Reply 2-3; '108 IPR Sur-Reply 6-7

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1. "a port must be on a module or housing"
2. "a port can only be 'one side' of two connectors mating," and
3. "a port is not 'coming from the sensor'"

All three "requirements" are written into the claims or logically consistent with Masimo's construction.

(1) a first sensor port positioned on a first side of the (3) housing, the first side of the housing configured to (2) face toward a hand of the arm of the patient when the housing is secured to the arm of the patient, the first sensor port

— '108 Patent at 13:27-30 (Claim 1)

See, e.g., '108 IPR Reply 2-3; '108 IPR Sur-Reply 6-7

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See, e.g., '108 IPR Reply 1-5; '108 IPR Sur-Reply 7

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4. *Masimo's construction lacks data input/output*

Sotera argues: *"a hardwired connection includes a conductor (a connector) soldered (mates) to another conductor (a compatible connector)."*

— '108 IPR Reply 4

- A mere conductor is not a "connector" or "compatible connector."
- No mating of two connectors in Sotera's soldered conductor example

See, e.g., '108 IPR Reply 1-5; '108 IPR Sur-Reply 7

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See, e.g., '108 IPR Reply 4-5; '108 IPR Sur-Reply 7

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4. *Masimo's construction lacks data input/output*

Data transmission between sensor and sensor port is already recited in the claims

> secured to the arm of the patient, the first sensor port configured to electrically receive a signal from a pulse oximetry sensor via a wired connection from the pulse oximetry sensor to the first sensor port, the wired

— '108 Patent at 13:30-33 (Claim 1)

See, e.g., '108 IPR Reply 4-5; '108 IPR Sur-Reply 7

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See, e.g., '108 IPR Reply 1-5

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"Sensor Port"– Sotera's Proposal on Reply

Sotera's Reply proposed:
"a permanent or removable input/output interface for a sensor"

- Contradicts Sotera's arguments and Yanulis' opinions in the Petition and original expert declaration that ports provide removable connections
- Contradicts the patents, which distinguish ports from hardwired connections
- Not supported by claim differentiation
- Based on irrelevant extrinsic evidence

See, e.g., '108 IPR Reply 1-5; '108 IPR Sur-Reply 3-7

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“Sensor Port” – Sotera Previously Argued for Removability

Sotera contradicts itself and its own expert to now argue sensor ports encompass “permanent” connections.

> In other words, a PHOSITA would know, using common sense and basic knowledge about the medical field, to build wired connections that allow for sensors to be readily connected and disconnected as needed, and ports were known to provide such adaptability. EX1003, ¶ 73; *KSR*,

— ’108 IPR Pet. 26

> One way to provide this adaptability is to connect wired connects through ports, which provide an end user the ability to disconnect and connect a variety of sensors as needed. Thus, because Goldberg teaches an

— ’108 IPR EX1003 (Yanulis Decl.) ¶ 73

See, e.g., ’108 IPR Sur-Reply 4

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Claim Differentiation Does Not Support Sotera

Dependent claims specify cable and how it is coupled

5. The portable patient monitoring device of claim **1** further comprising:

a cable providing the wired connection from the pulse oximetry sensor to the first sensor port.

6. The portable patient monitoring device of claim **5**, wherein the cable is configured to be removably coupled to the housing via the first sensor port.

'108 IPR Reply 3; '108 IPR Sur-Reply 5; '108 IPR EX1001 at Claims 5-6; see also '735 IPR Reply 3; '735 IPR Sur-Reply 5-6; '623 IPR Reply 3; '623 IPR Sur-Reply 3.

Sotera's Extrinsic Evidence Is Unrelated to Sensor Ports

- Sotera's new expert Bergeron argues a microcontroller datasheet shows *"processor pins soldered to a breakout board."* — '108 IPR EX1040 ¶ 49.

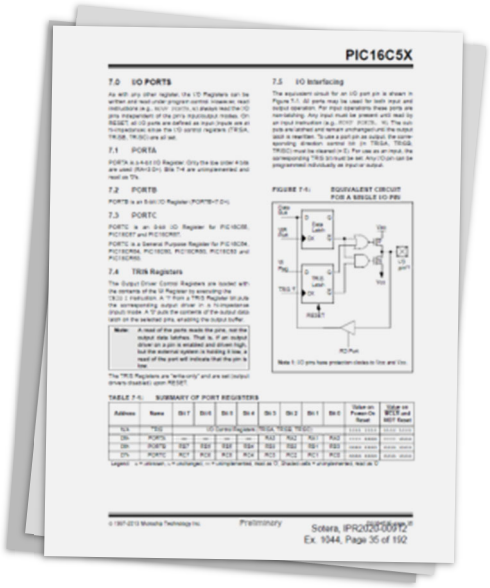

MICROCHIP

PIC16C5X

EPROM/ROM-Based 8-bit CMOS Microcontroller Series

Preliminary

Sotera, IPR2020-00972
Ex. 1044, Page 1 of 192


PIC16C5X

Preliminary

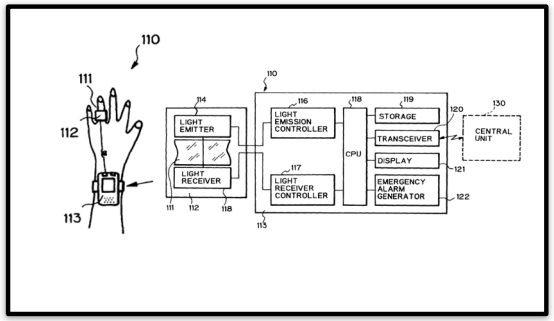
Sotera, IPR2020-00972
Ex. 1044, Page 35 of 192

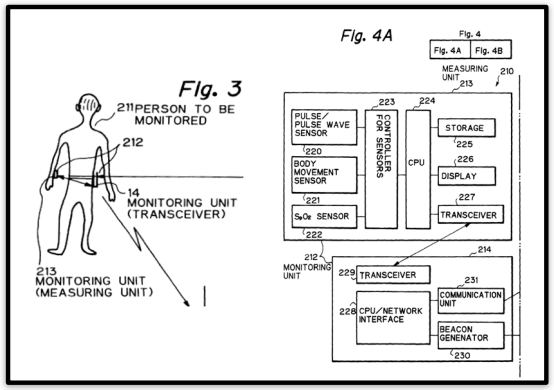
"Processor pins soldered to a breakout board" are **not** the "sensor ports" in the claimed invention.

See, e.g., '108 IPR Reply 3; '108 IPR Sur-Reply 5-6

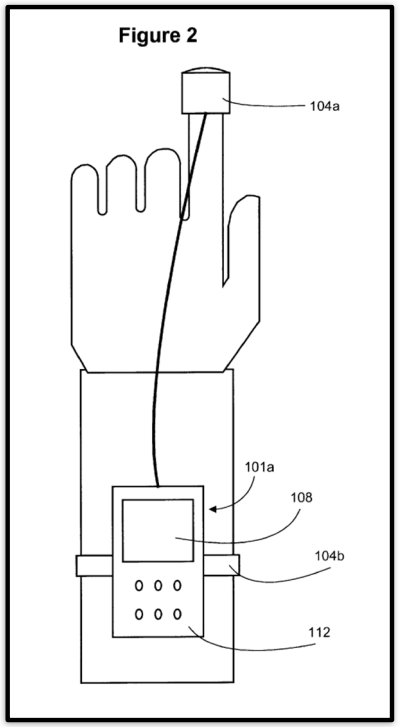
Three Types of Grounds

Akai-based Grounds

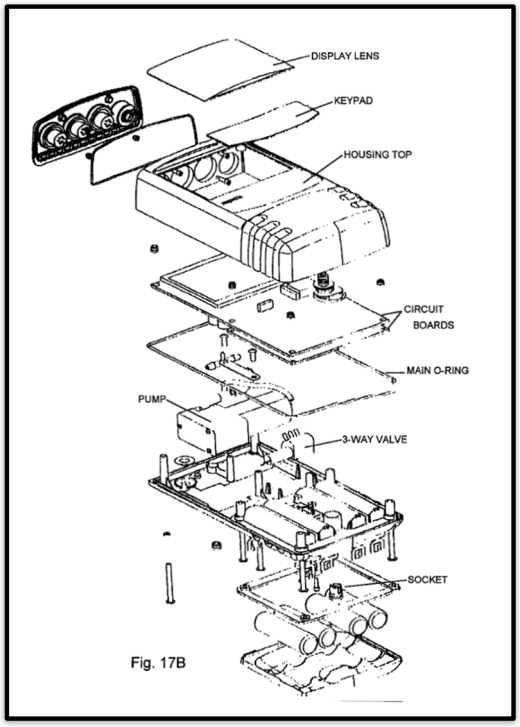




Goldberg-based Grounds



Money-based Grounds



Akai at Figs. 1-4A; Goldberg at Fig. 2; Money at Fig. 17B

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

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AKAI-BASED GROUNDS ('108 IPR ONLY)

Instituted Akai Grounds

'108 IPR Ground	Cited Prior Art	'108 Patent Claims at Issue
2	Akai and Kiani	1-5, 9-18
4	Akai, Kiani, and Fujisaki	6-8
6	Akai, Kiani, and Money	19-22

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Challenges to the Akai-Based Grounds

- PHOSITA would not have combined Akai's 1st and 2nd embodiments
- PHOSITA would not have modified Akai to add sensor ports
- PHOSITA would not mount a strap to back of Akai's measuring unit 213
- Proposed combination does not have a "first sensor port configured to electrically receive a signal from a pulse oximetry sensor" as required by all independent claims in the '108 Patent

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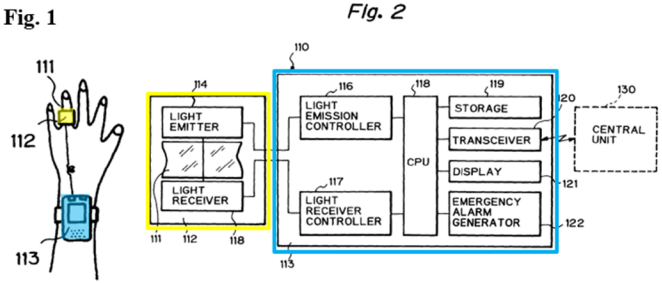
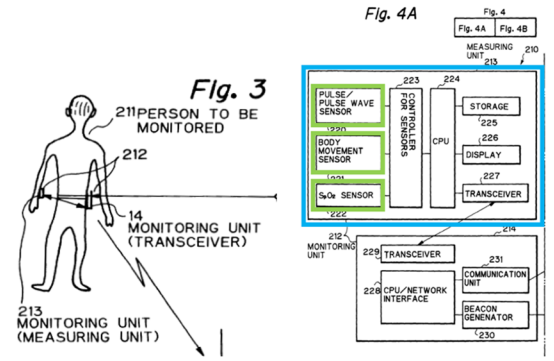
No Reason to Combine Akai's Distinct Embodiments

First Akai Embodiment (Figs. 1 and 2) – External Sensors



EX1007 at Figs. 1-2 (cropped and annotated)

Second Akai Embodiment (Figs. 3 and 4) – Internal Sensors



Id. at Figs. 3-4A (cropped and annotated)

Sotera & Yanulis argued for combining Akai's first and second embodiments because:

1. *Locations of the sensors in Akai's second embodiment are "unclear"*
2. *PHOSITA would combine the two embodiments so that the pulse sensor and SpO_2 sensor can have adequate skin contact*

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Akai's 2nd Embodiment Clearly Describes Internal Sensors

- Akai's figures and specification clearly describe the 2nd embodiment as having sensors that are part of the housing (not connected externally)
  - *See* Oslan Decl. (EX2010) ¶¶ 121-125

> Measuring unit 213 comprises pulse wave/pulse rate sensor 220, body movement sensor 221, SpO2 sensor 222, controller for the sensors 223, CPU 224, storage 225, display 226, and transceiver 227 for communicating with transceiver 230 in monitoring unit 212 by means of week radio waves.

— Akai at 7:51-57

Sotera's Expert Understands These Sensors Are Internal to the Housing

Yanulis ***agreed*** during deposition that the sensors in Akai's second embodiment are part of the measuring unit

Q. So would you agree that each of the pulse wave sensor, the body movement sensor, and the SpO2 sensor is internal of the housing?

A. It's internal to the housing but there has to be some kind of sensor wires that attach to this to allow you to obtain those measurements.

Q. What do you mean by that?

A. Yes, I'll just say that the sensors are internal, but there's some kind of communication that will allow -- the sensors are internal, let's leave it at that.

— EX2013 at 211:16-212:4

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Akai's Second Embodiment Already Has Skin Contact

> However, measuring unit 213 has to be in contact with the skin since the physical data is measured directly from the skin.

— Akai at 7:49-51

Sotera's Experts Disagree Whether the Sensors in Akai's 2nd Embodiment Are Internal or External

Yanulis (Internal)

Q. So would you agree that each of the pulse wave sensor, the body movement sensor, and the SpO2 sensor is internal of the housing?

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Q. What do you mean by that?

A. Yes, I'll just say that the sensors are internal, but there's some kind of communication that will allow -- the sensors are internal, let's leave it at that.

— Yanulis Depo Tr. (EX2013) at 211:16-212:4

Bergeron (External)

Instead, a POSITA would read Akai to suggest that each sensor that is attached to the body is taped or clipped on a body part separate from the wrist-mounted unit, such as an EKC sensor or the SpO_2 sensor 112 shown in FIG. 1.

— Bergeron Decl. (EX1040) ¶ 94

Akai also teaches an air-pad attached to a person's body and a thin-film resistor attached to a patient's body. EX1007, 5:7-9, 7:44-46, 8:14-17, 8:21-23. Each of these two devices would include wires. Plus, it is my opinion that the SpO_2 sensor 222 of the second embodiment attaches to the finger, like in FIG. 1.

— Bergeron Decl. (EX1040) ¶ 100

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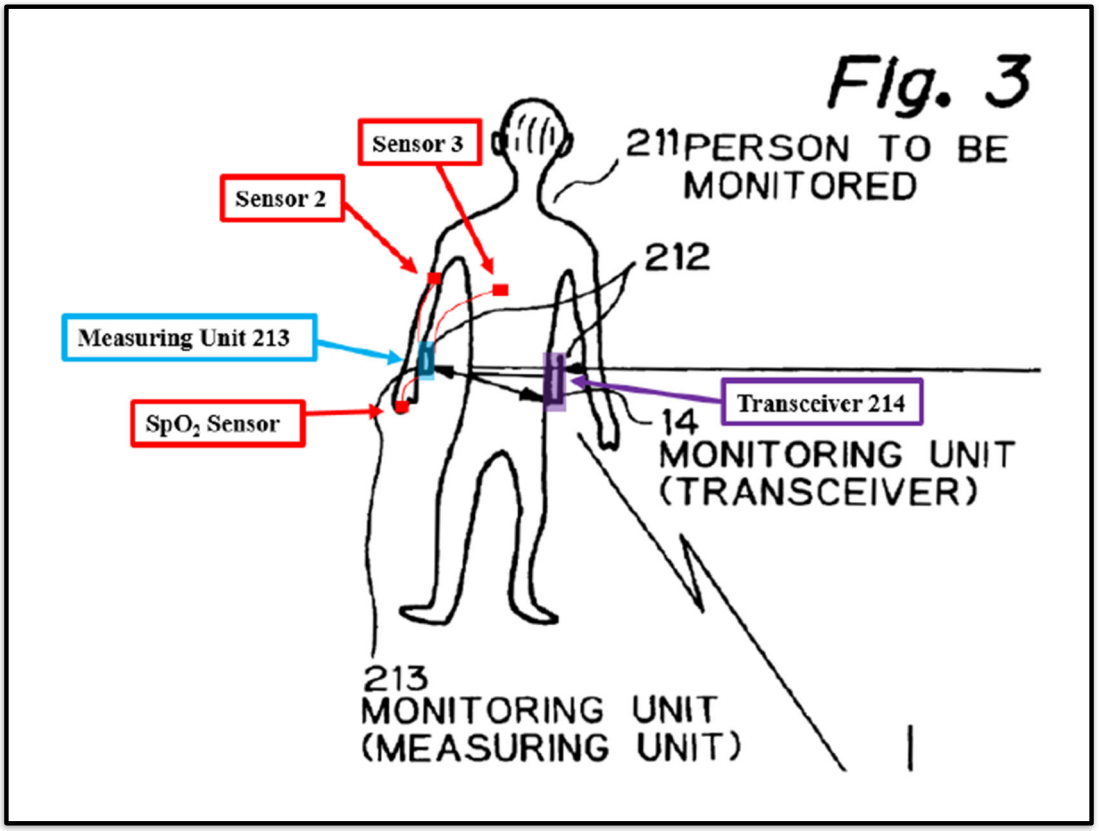
No Reason to Add Sensor Ports to Akai's 2nd Embodiment



— '108 IPR POR 62 (annotating Akai Fig. 3)

'108 IPR POR 62-63; '108 IPR EX2010 ¶¶ 128-135

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No Reason to Add Sensor Ports to Akai

- Modification proceeds ***against*** Akai's expressed design goal of maintaining patient's quality of life:

> Even though appropriate monitoring is possible by using a device, if the use of such a device restricts everyday life and lowers the quality of life (QOL), then such

— Akai at 1:56-2:1

> Measurements of the parameters will be made in accordance with the following method while considering that measuring unit 213 is small in size and attached to the person's body in such a manner that does not compromise the QOL of the person. The present invention

— Akai at 8:4-8

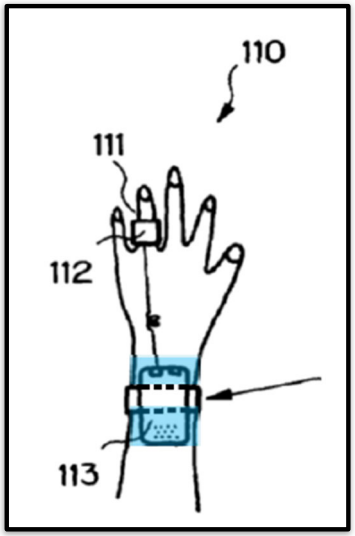
- Modification proceeds ***against*** Yanulis' opinion:

> communication with medical sensors or wireless data transmission. Generally, when designing wearable technology, PHOSITAs mainly attempted to improve patient comfort when the device is being worn. However, the best way to improve patient comfort would be to minimize the size of the wearable device and the number of sensors attached to the patient. None of the claims are directed to this problem. Instead, the claims are directed to a conventional wired port's location on

— EX1003 ¶ 29

Back-Mounted Strap Would Prevent Sensor/Skin Contact

- Claims 1 and 19 recite a “strap mountable to a back side of the housing”
- Sotera relies on Akai Fig. 1 (1st embodiment) for this feature. ’108 IPR Pet. 49.
- But measuring unit 213 (2nd embodiment) “has to be in contact with the skin.” Akai at 7:49-51.
- Strap on back of housing could block the sensors.



’108 IPR Reply 26 (annotating Akai Fig. 1)

In Reply, Sotera argues that a strap could be attached to the back of the housing while allowing skin contact in the blue areas:

’108 IPR Sur-Reply 24 (citing EX1045)

But Sotera’s own evidence shows that a strap on the back would lift the device above the skin.

’108 IPR POR 62; EX2010 ¶¶ 136-137; ’108 IPR Reply 25-27; ’108 IPR Sur-Reply 22-24

Sotera's New Arguments in Reply

- Sotera introduced new and different arguments on Reply. Sotera and new expert Bergeron now argue:
  1. *Sensors in 2nd embodiment are already external. '108 IPR Reply 27-28.*
  2. *Newly identified portion of Akai allegedly shows express motivation to combine. Id. at 24.*
  3. *PHOSITA would also combine 1st, 2nd, and 3rd Akai embodiments. Id. at 24 n.6.*
- Not included in Petition

'108 IPR Reply 21-24, 27; '108 IPR Sur-Reply 2, 18-22

Proposed Combination Fails to Teach "Electrically Receive"

All independent claims in '108 Patent require the first sensor port to "electrically receive" a signal from a pulse oximetry sensor

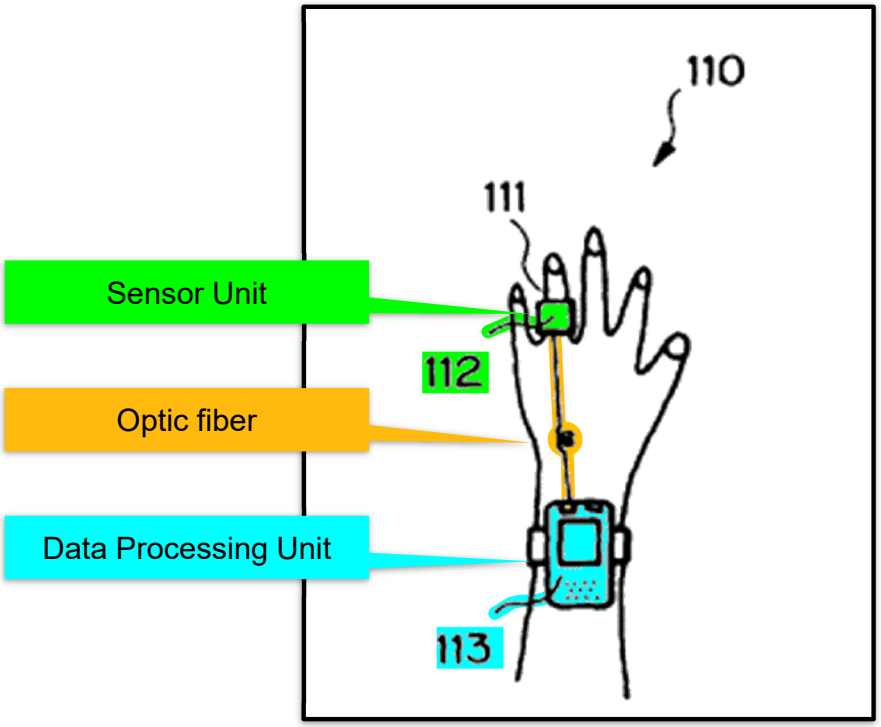
Note: Independent Claims 17 and 21 recite methods of using the devices in Claims 1 and 19, respectively.

Limitation 1(e)	a first sensor port positioned on a first side of the housing, the first side of the housing configured to face toward a hand of the arm of the patient when the housing is secured to the arm of the patient,
Limitation 1(f)	the first sensor port configured to electrically receive a signal from a pulse oximetry sensor via a wired connection from the pulse oximetry sensor to the first sensor port,
Limitation 19(d)	a first sensor port positioned on a first side of the housing, the first side of the housing configured to face toward a hand of the arm of the patient when the housing is secured to the arm of the patient,
Limitation 19(e)	the first sensor port configured to electrically receive a signal from a pulse oximetry sensor via a wired connection from the pulse oximetry sensor to the first sensor port,

— '108 IPR Pet. xii, xvi (claim listing)

Proposed Combination Fails to Teach "Electrically Receive"

Sotera relies on Akai's "optic fiber."



— Akai at Fig. 1 (annotated)

f. Limitation 1(f)

Akai teaches the CPU 118/224 receives electrical signals representing SpO_2 of the monitored person from the pulse oximetry sensor 112/222 via the wired connection shown in FIG. 1. EX1007, 6:10-14, 26-32. As explained above in

— '108 IPR Pet. 53.

121, and emergency sound generating unit 122. Further, data processing unit 113 has an appropriate interface such as an optic fiber between itself and sensor unit 112.

— Akai at 5:14-17

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Sotera's Reply Changed Its Akai Combination to Include an Electrical Wire

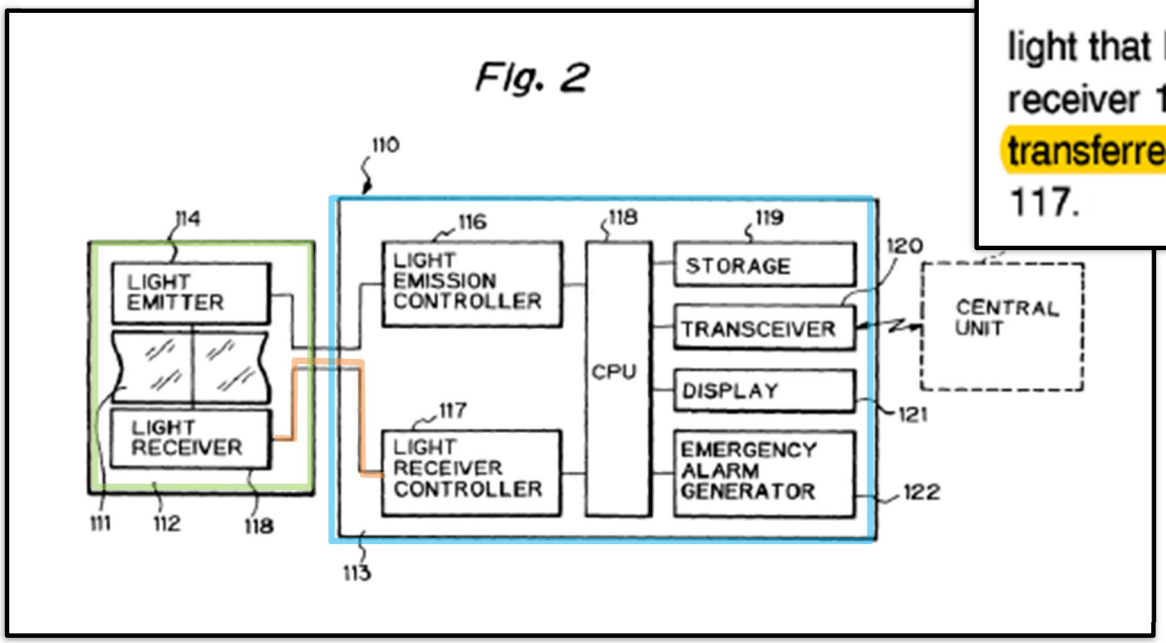
D. The Combination Does Teach "electrically receive a signal" from an SpO_2 Sensor

Masimo argues Akai fails to teach a port that electrically receives a signal from the SpO_2 sensor because Akai mentions a fiber optic cable. However, Akai teaches a fiber optic cable only as an example ("such as an optic fiber"). EX1007, 5:14-19. Masimo ignores that Akai also suggests a connection using "a material having an appropriate flexibility," which a PHOSITA would know includes a wire. EX1040, ¶ 101. A PHOSITA understands Akai's light receiver would send electrical signals if connected to an electrical conducting wire or optical signals if connected to a fiber optics cable. *Id.* Thus, Akai teaches electrical transmission from the SpO_2 sensor to the wrist unit. *Id.*

— '108 IPR Reply 28.

Sotera's Reply Changed Its Akai Combination to Include an Electrical Wire

- But Akai's sensor 112 would not work if the fiber optic cable is replaced with electrical wire. — '108 IPR Sur-Reply 25.



. The light that has permeated finger 111 is received by light receiver 115 located at the other side of the finger and transferred via an optic fiber to controller of light receiver 117.

Note: Light receiver 115 is appears to be mislabeled as 118 in Akai's Fig. 2. '108 IPR Sur-Reply 25.

— Akai at Fig. 2, 5:26-30

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Undisputed that an Electrical Wire Cannot Transmit Light

Q. Are you familiar with optical fibers?

A. Somewhat, yes.

Q. And optical fibers transfer light. Correct?

A. That is the purpose, yes. And data over light, yes.

Q. And electrical wires cannot transfer light. Correct?

A. Normally that is correct, yes.

— Bergeron Depo. Tr. (EX2038) at 181:19-182:6

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GOLDBERG-BASED GROUNDS (ALL IPRS)

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Instituted Goldberg Grounds

'108 IPR Ground	Cited Prior Art	'108 Patent Claims at Issue
1	Goldberg and Kiani	1-5, 9-18
3	Goldberg, Kiani, and Fujisaki	6-8
5	Goldberg, Kiani, and Money	19-22
'735 IPR Ground	**Cited Prior Art**	**'735 Patent Claims at Issue**
1	Goldberg, Kiani, and Money	1-2, 7-9
2	Goldberg, Kiani, Money, and Fujisaki	3-6, 13-19
3	Goldberg, Kiani, Money, and Estep	10-12
4	Goldberg, Kiani, Money, Fujisaki, and Estep	20
'300 IPR Ground	**Cited Prior Art**	**'300 Patent Claims at Issue**
1	Goldberg, Kiani, and Money	1-20
3	Goldberg, Kiani, Money, and Taylor	1-5, 10-20
5	Goldberg, Kiani, Money, Taylor, and Hylton	6-9
'623 IPR Ground	**Cited Prior Art**	**'623 Patent Claims at Issue**
1	Goldberg and Kiani	1-2, 4-5, 12, 14-17
2	Goldberg, Kiani, and Fujisaki	3
3	Goldberg, Kiani, and Money	6-11, 13, 18-19
4	Goldberg, Kiani, Money, Fujisaki, Estep, Taylor, and Hylton	20

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Challenges to the Goldberg-Based Grounds

- Goldberg does not disclose any sensor ports
- PHOSITA would not be motivated to modify Goldberg in view of Kiani to add three sensor ports
- No motivation to add a sensor port between Goldberg's blood pressure cuff and housing, and no reasonable expectation of success

See, e.g., '108 IPR POR 23-51

Goldberg Does Not Disclose Any Sensor Ports

- Sotera argues Goldberg discloses sensor ports *"because Goldberg shows that a wire extends between the pulse oximetry sensor 104a and into the housing 112 and because Goldberg teaches the controller 102 receives electronic signals from the sensor 104a."*

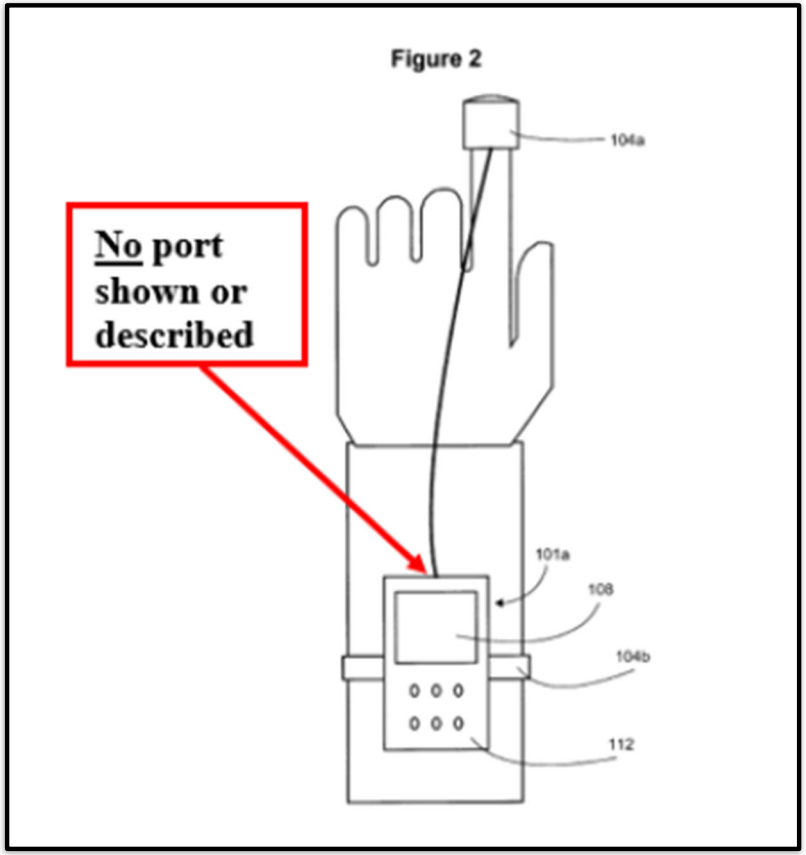
  — '108 IPR Pet. 25.

- Goldberg figures and detailed description do not show or describe even a single sensor port.

  — *See, e.g.,* '108 IPR POR 25; '108 IPR Oslan Decl. (EX2010) ¶¶ 63-65

- Figure 2 depicts a hardwired connection between sensor 104a and housing 112.

  — '108 IPR Oslan Decl. (EX2010) ¶¶ 63-65



— Goldberg Fig. 2 (annotated)

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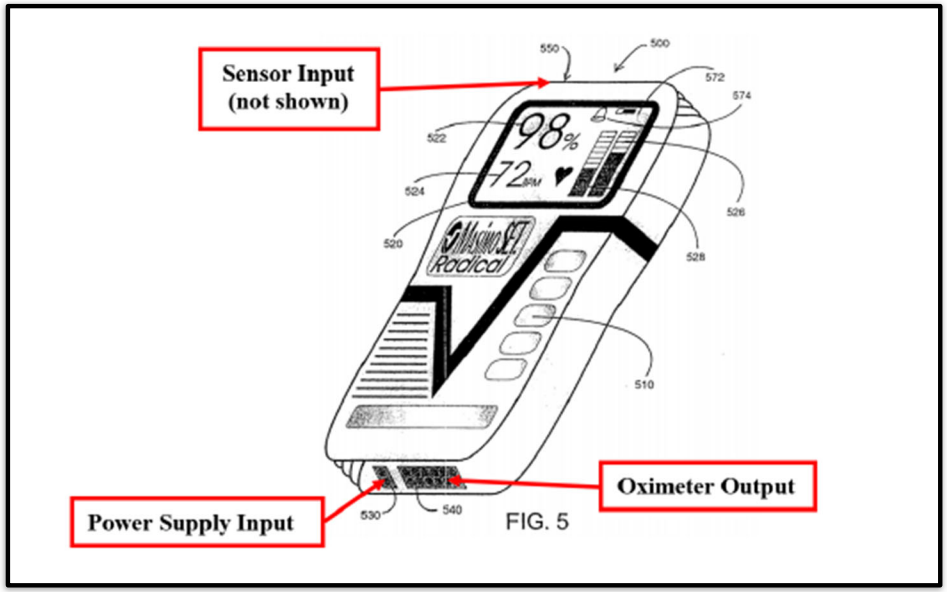
Kiani Does Not Disclose Multiple Sensor Ports

- Sotera incorrectly argued Kiani discloses multiple sensor ports.
  - Sotera argues that PHOSITA would modify Goldberg in view of Kiani to add multiple sensor ports.
    — '108 IPR Pet. 26.
- Yanulis agreed in deposition: Kiani only has one sensor input port 550.
  — EX2013 at 131:16-18.



— Kiani at Fig. 5 (annotated)

See, e.g., '108 IPR POR 27-28

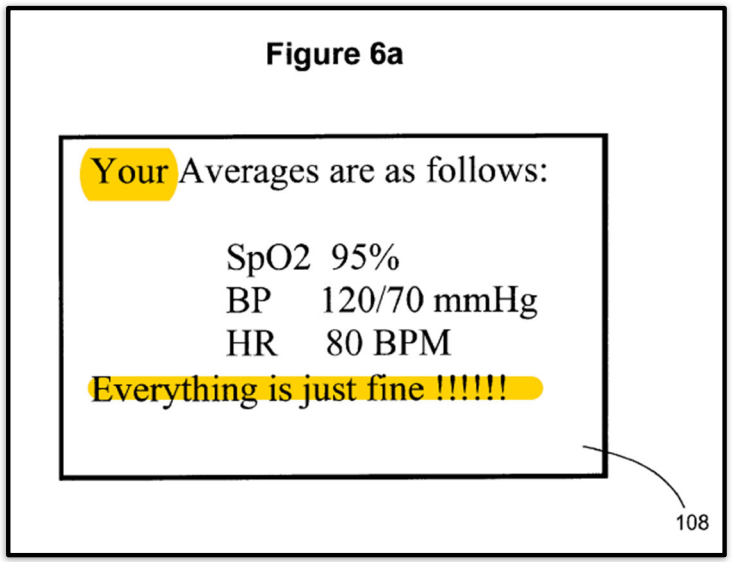
No Motivation to Combine Goldberg and Kiani

- Sotera argues a PHOSITA would combine Goldberg and Kiani to add ports to Goldberg because *"clinicians demand and expect patient monitors that conform and adapt as needed, based on a particular patient, the patient's aliment (sic), and the monitored vital signs associate (sic) with that ailment."*
  — '108 IPR Pet. 26.
- Alleged motivation is based on flawed premise that **clinicians** are the end-users for Goldberg's device, but Goldberg's device is intended for **personal use**
- Adding more sensor ports and sensors proceeds against Sotera's expert's opinion that "the best way to improve patient comfort would be to minimize the size of the wearable device and the number of sensors attached to the patient."
  — EX1003 ¶ 29

See '108 IPR Pet. 26; '108 IPR POR 31-34; '108 IPR EX2010 ¶¶ 71-74

No Motivation to Combine Goldberg and Kiani

Goldberg's device is intended for **personal use**



— Goldberg at Fig. 6a

BACKGROUND OF THE INVENTION

The present invention relates generally to a portable medical monitoring device that is sized to be carried by a monitored person, and more particularly, to a portable device that receives data provided by one or more sensors and displays statistical data related to the sensor data. The

— Goldberg at 1:5-10

The portable device may also include in one embodiment an integrated content retrieval function for the display of content information related to, for example, news, sports, or entertainment on the display device **108**. FIG. **4** illustrates a

— Goldberg at 5:54-57

'108 IPR POR 31-34; '108 IPR EX2010 ¶¶ 71-74; *see also* Goldberg at Figs. 6b-6c

No Motivation to Combine Goldberg and Kiani

- Sotera argues a layperson *"desires customization so that she monitors the parameters important for her."* — '108 IPR Reply 16.
- Sotera argues that *"[t]he average home user was very familiar with ports in 2002"* — '108 IPR Reply 16.
- But Oslan testified:

> That article also explained that "The multitude of cables and tubing that were connected to the typical patient was also seen to be a problem. … There were several instances observed where the patient was nearly engulfed in cable, and when a nurse had to check the machines or the cables, you could see her tracing each one from patient to machine." *Id.* at 112. If complicated and messy cables were already a problem for professional healthcare workers in the ICU, a PHOSITA would not be motivated to replicate that problem for the home user.

— '108 IPR EX2010 ¶ 74

See, e.g., '108 IPR Reply 16; '108 IPR EX1040 ¶ 80; '108 IPR Sur-Reply 13-15.

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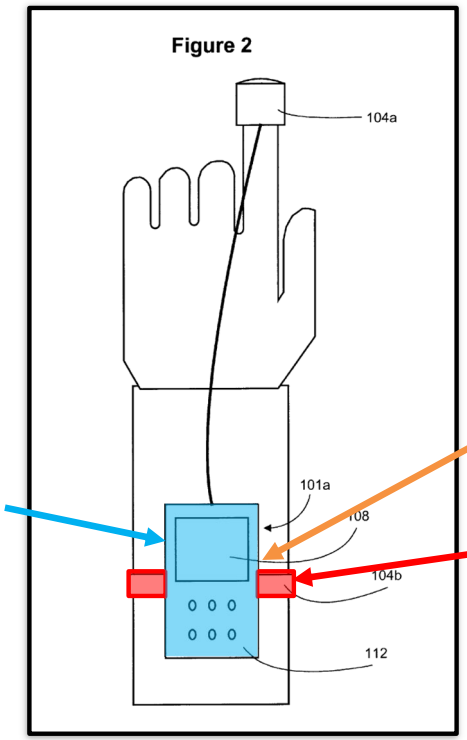
No Sensor Port Between Goldberg's Blood Pressure Cuff and Housing



Housing 112

Sensor port between cuff and housing?

Blood pressure cuff sensor 104b

'108 IPR Pet. 28-29; '735 IPR Pet. 26-29, 56; '300 IPR Pet. 19-20, 25; '623 IPR Pet. 31-32.

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No Sensor Port Between Goldberg's Blood Pressure Cuff and Housing

- Pressure sensor is normally located within the housing, not the cuff
- Hypothetical sensor port would need to have:
  - Airtight pneumatic connection
  - Sufficiently strong retention mechanism to keep housing attached to the cuff and withstand sudden forces from patient movement
  - Electrical connection to pressure sensor
  - Removable connection
- Sotera has not shown any sensor port that can work in proposed combination
  - No reasonable expectation of success
- Mr. Oslan: "This combination would require a PHOSITA to design and develop a new sensor port, not shown anywhere in Petitioner's references, to address these issues." — '108 IPR EX2010 ¶ 88.

See, e.g., '108 IPR POR 35-41; '108 IPR EX2010 ¶¶ 78-97.

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No Reason to Add a Sensor Port

- Sotera's expert claims that a sensor port would *"allow[] removal and replacement of the sensor 104b and provid[e] a secure, wired connection between the blood pressure sensor 104b and the housing 112."*
  — '108 IPR EX1003 ¶ 81.
- No evidence of wrist-worn blood pressure monitors ***before or after*** 2002 designed to be user-removable from their housing. — '108 IPR EX2010 ¶¶ 89-97.

See, e.g., '108 IPR POR 35-41; '108 IPR EX2010 ¶¶ 78-97.

Sotera's Three New Reply Arguments Fail

1. Reference numeral 104b is "blood pressure cuff sensor," which implies the electrical sensor is outside of Goldberg's housing

- No electrical sensor shown outside of Goldberg housing
- Sotera admits Fig. 2 lacks details. '108 IPR Reply at 7

2. Goldberg discloses "other embodiments [that] include separate blood pressure sensors that are not also integrated as a strap for a housing."

- Improper new evidence
- Relying on other embodiments would eliminate strap feature

3. New reference EX1043 (U.S. Pat. 4,889,132 to Hutcheson et al.) shows some blood pressure cuffs used microphones to detect Korotkoff sounds

- No sensor port

See, e.g., '108 IPR Reply 17-19.

Additional Challenges to Goldberg-Based Grounds

- Proposed combinations of Goldberg with Money do not teach the specific digital/analog signal limitations
- Estep and Hylton not analogous art (also applicable to Money-based grounds)
- '300 IPR: Petitioner's arguments are based on cross-references to non-existent sections

See, e.g., '108 IPR POR 45-51; '623 IPR POR 64-65; '300 IPR POR 16

Sotera's Proposed Combinations Do Not Teach Claimed Digital/Analog Signal Limitations

- Some claims require one sensor port receive analog info from a pulse oximetry sensor and another sensor port receive digital info from another sensor
- Examples:
  - '108 Patent Claim 19
  - '735 Patent Claims 1, 20
  - '300 Patent Claims 1, 16

a first sensor port positioned on a first side of the housing, the first side of the housing configured to face toward a hand of the arm of the patient when the housing is secured to the arm of the patient, the first sensor port configured to electrically receive a signal from a pulse oximetry sensor via a wired connection from the pulse oximetry sensor to the first sensor port, the signal from the pulse oximetry sensor including analog information;

a second sensor port positioned on the housing and configured to receive a signal from a second sensor arrangement via a wired connection, the signal from the second sensor arrangement including digital information;

— '108 Patent at 15:40-52 (Claim 19)

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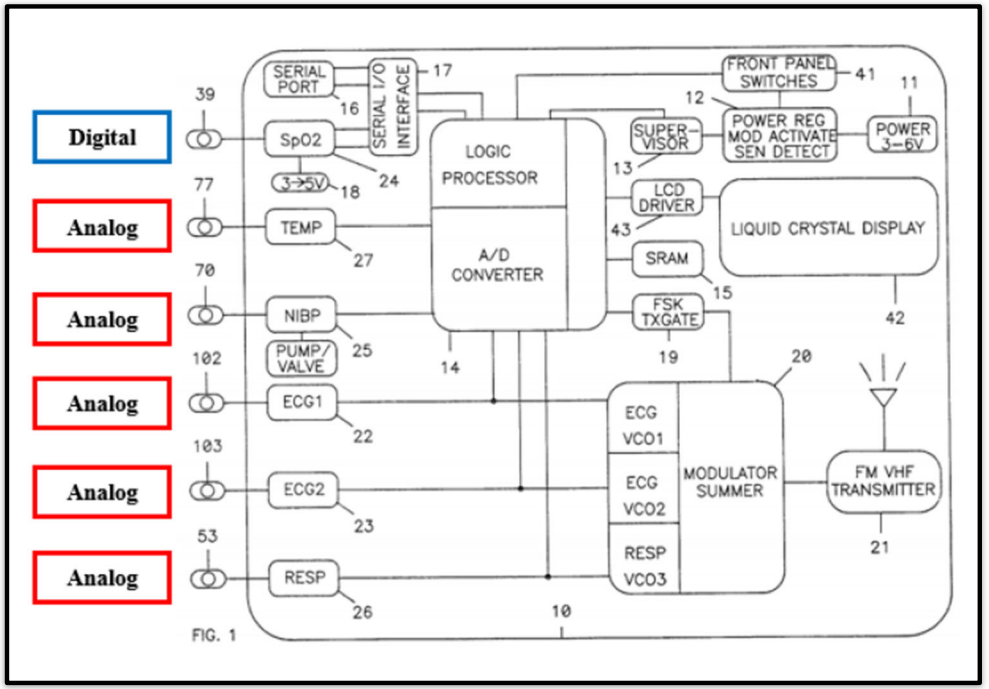
Money Discloses the Opposite of the Claimed Digital/Analog Signal Limitations

- Money does not disclose the claimed arrangement of receiving (1) analog information from pulse oximetry sensor, and (2) digital information from other sensor.
- Undisputed by Sotera



— '108 IPR POR 47 (Money at Fig. 1 (annotated)).

See, e.g., '108 IPR Pet. 78-79; '108 IPR POR 45-49; '735 IPR Pet. 26-29; '735 IPR POR 44-47; '300 IPR Pet. 25-30; '300 IPR POR 36-42.

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Sotera's Replies Present Improper New Claim Interpretations

- '108 IPR: *"claim 19 only requires that the second signal 'include digital information,' not be a purely digital signal. It was known to encode digital information on an analog signal."* — '108 IPR Reply 20.
- Sotera did not:
  - identify any prior art sensor that transmits digital information on an analog signal, and
  - explain a motivation to modify Goldberg to do so

See, e.g., '108 IPR Reply 20; '108 IPR Sur-Reply 15-16;

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’300 IPR: Deficient Cross-References

- Sotera’s Goldberg-based arguments for limitations 16(d) and 16(e) in ’300 IPR are cross-references to Sections IX.A.11.a.-b.
  - Those sections don’t exist.

> **d. Limitation 16(d)**
>
> *See* Section IX.A.11.a.
>
> **e. Limitation 16(e)**
>
> *See* Section IX.A.11.b.

— ’300 IPR Pet. 45

- Sotera’s arguments for limitation 16(h) are also based on a cross-reference to an argument about modifying Money’s temperature sensor that Sotera did not make. — See ’300 IPR Pet. 46.

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MONEY-BASED GROUNDS ('735, '300, AND '623 IPRS)

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Instituted Money Grounds All Require Combination with Akai

'735 IPR Ground	Cited Prior Art	'735 Patent Claims at Issue
5	Money, Akai, and Kiani	1-2, 7-9
6	Money, Akai, Kiani, and Fujisaki	3-6 and 13-19
7	Money, Akai, Kiani, and Estep	10-12
8	Money, Akai, Kiani, Fujisaki, and Estep	20

'300 IPR Ground	Cited Prior Art	'300 Patent Claims at Issue
2	Money, Kiani, and Akai	1-20
4	Money, Kiani, Akai, and Taylor	1-5, 10-20
6	Money, Kiani, Akai, Taylor, and Hylton	6-9

'623 IPR Ground	Cited Prior Art	'623 Patent Claims at Issue
5	Money, Kiani, and Akai	1-2, 4-19
6	Money, Kiani, Akai, and Fujisaki	3
7	Money, Kiani, Akai, Fujisaki, Estep, Taylor, and Hylton	20

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Challenges to Money-Based Grounds

- No factual basis for asserting that Money's pulse oximetry cuff transducer is *"bulky," "uncomfortable,"* or *"obsolete."*
- Sotera reconstructs the claimed inventions with hindsight reasoning
  - PHOSITA would not have selected Money as a reference
  - Money's device is too large and bulky to be wrist-worn
  - No motivation to combine Money and Akai
- Proposed combination does not teach "electrically receive" a signal

See, e.g., '623 IPR POR 49-64; '735 IPR POR 51-70; '300 IPR POR 47-66

No Factual Basis for Core Argument to Replace Money's Cuff Transducer with Akai's SpO_2 sensor

- Sotera argues for replacing Money's cuff transducer with Akai's finger sensor
- Sotera and Yanulis disparage Money's pulse oximetry cuff transducer as *"bulky," "uncomfortable," "obsolete"*
- Sotera and Yanulis also imply that Money's pulse oximetry cuff transducer was *invasive* and *not light-based*

'735 IPR Pet. 63-64; '735 IPR EX1003 ¶ 195; '300 IPR Pet. 58; '300 IPR EX1003 ¶ 173; '623 IPR Pet. 62; '623 IPR EX1003 ¶ 236.

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Sotera's Expert Could Not Explain The Cuff Transducer

Q. What is your understanding of what a pulse oximetry cuff looks like?

A. I'll be honest with you, Counsel, I've not seen many, and I can't recall when I have seen one. Most of the ones I've seen in this time frame that are pretty well-known utilize the

So I'll be honest with you, I have not seen any.

were left after being absorbed. So I'll be honest with you, I have not seen any. I know they existed, but I don't recall ever seeing one.

— EX2013 (Yanulis Depo.) 233:18-234:7

Q. Can you describe for me any features of the pulse oximetry cuff transducer?

A. Honestly, I -- I couldn't, because I'd have to go back, and look at some of the old pulse pressure cuff. To be completely transparent, at this time I could not. I could after looking at a few. I really didn't spend a lot of time because that's not the current technology.

Obviously, I did look at Akai. But, again, Akai is not the way they do things. During this time with this patent. The prior art utilized in the IPR that was used for the '735 declaration -- or in the other declaration.

So the answer -- simple answer, no, I don't know any specifics. And I'm not sure you'd want to use a cuff, because they're very uncomfortable.

— EX2013 (Yanulis Depo.) 235:21-236:15

See, e.g., '623 IPR POR 49-51

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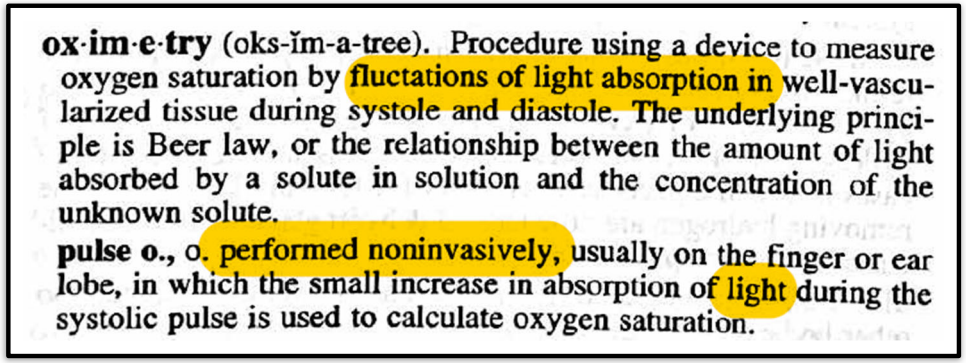
Proposed Replacement Is Unsupported

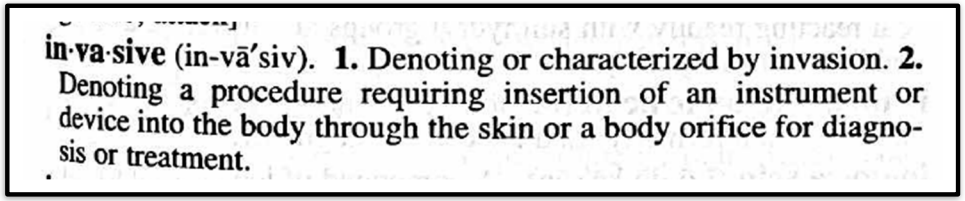
- PHOSITA would know that pulse oximetry is performed non-invasively using light
  - No motivation to substitute Money's pulse oximetry cuff transducer with Akai's sensor



ox·im·e·try (oks-ĭm-a-tree). Procedure using a device to measure oxygen saturation by fluctations of light absorption in well-vascularized tissue during systole and diastole. The underlying principle is Beer law, or the relationship between the amount of light absorbed by a solute in solution and the concentration of the unknown solute.

pulse o., o. performed noninvasively, usually on the finger or ear lobe, in which the small increase in absorption of light during the systolic pulse is used to calculate oxygen saturation.

— EX2017 (Stedman's Medical Dictionary) at 1292



in·va·sive (in-vā′siv). **1.** Denoting or characterized by invasion. **2.** Denoting a procedure requiring insertion of an instrument or device into the body through the skin or a body orifice for diagnosis or treatment.

— EX2017 (Stedman's Medical Dictionary) at 919

See, e.g., '623 IPR POR 57-60; '623 IPR EX2017; '623 IPR EX2010 ¶ 46

Reply Raises New Evidence and Argument

- Sotera relies on Merrick (EX1057, U.S. Pat. 4,883,055) to argue that *"SpO2 cuff transducers, like a blood pressure cuffs [sic], squeeze arteries to measure SpO2."* — '623 IPR Reply 24.
- Merrick ≠ Money
  - Merrick is not Money's "pulse oximetry cuff transducer"
  - Merrick uses a cuff to artificially induce a stronger-than-normal pulse for use with a pulse oximeter. — EX1057 at 1:66-68.

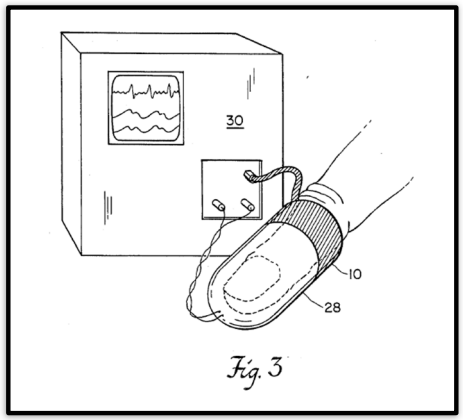


Fig. 3

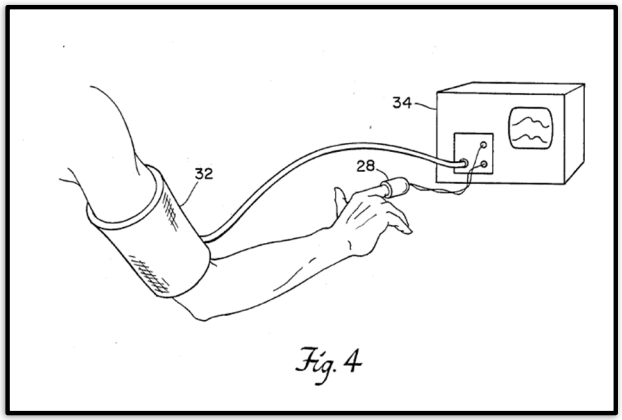


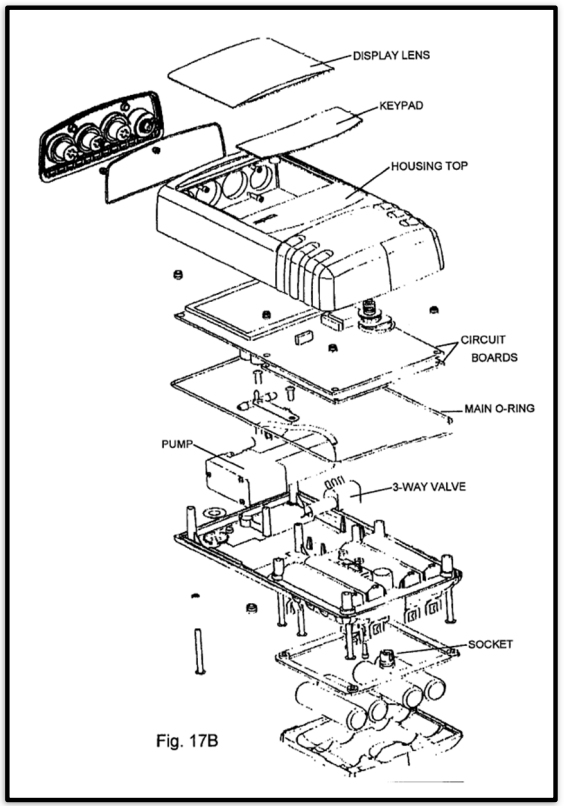
Fig. 4

— EX1057 at Figs. 3-4

See, e.g., '623 IPR Reply 24; '623 IPR Sur-Reply 15-16

Sotera's Selection of Money Is Based on Hindsight

- Money is too large and bulky to be wrist-worn
- Sotera relied on Money's device being 3" × 6" × 1".
  — *See, e.g.,* '623 IPR Pet. 65.
- Money's device weighs up to 16 oz. and requires 4 AA batteries
- Similar in size and weight to **three** smartphones stacked on top of each other



— Money at Fig. 17B

See, e.g., '623 IPR POR 52-54; EX2010 ¶¶ 130-135

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Sotera Changes Its Argument in Reply

In Replies, Sotera improperly changed its argument to argue Money's device could be made smaller based on Moore's Law.

- But Petitions expressly relied on the dimensions of Money's device.

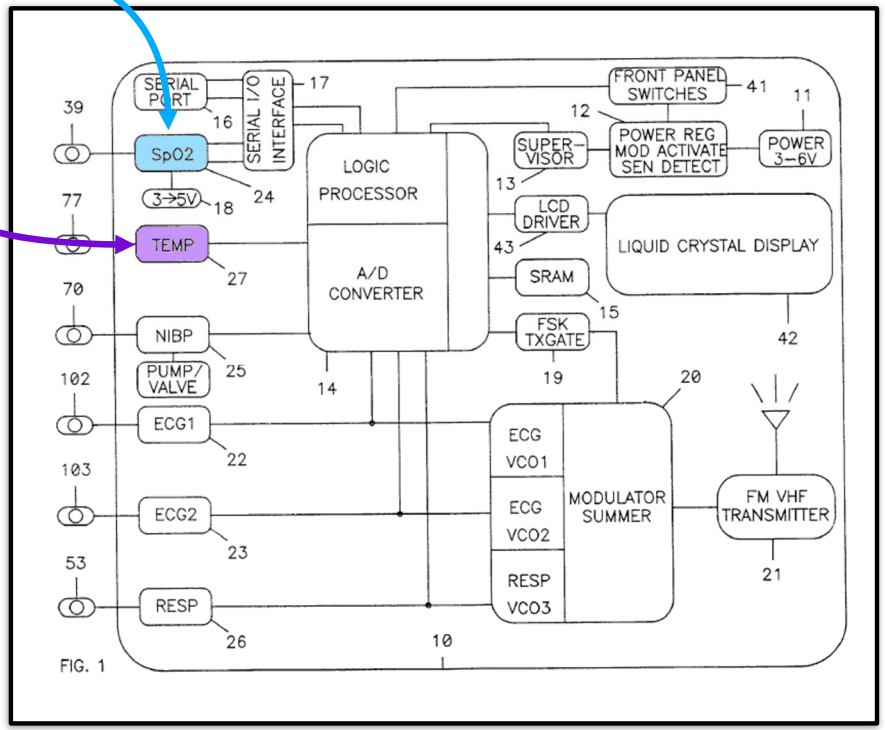
> **f. Limitation 1(f)**
>
> Money teaches a wearable housing. EX1008, 5:4-8; EX1003, ¶ 244. Money teaches the housing's dimensions are three inches wide, six inches long, and one-inch thick. A housing having these dimensions is sized and shaped to be worn on a patient's lower arm. *Id.*

— '623 IPR Pet. 65

See, e.g., '623 IPR Reply 20-22; '623 IPR Sur-Reply 16-21

Sotera's Proposed Combination Is Based on Hindsight

- Money already had a working SpO2 sensor and temperature sensor
  - Replace Money's cuff transducer with Akai's finger sensor
  - Akai's sensor is analog, Money's SpO_2 port is digital → plug Akai's sensor into another port
  - Money's digital SpO_2 port is unused
  - Remove Money's analog temperature sensor from its port
  - Change the temperature sensor to digital
  - Plug it in Money's digital SpO_2 port
- By modifying Money, Sotera creates problems that did not exist and then uses those problems to justify further modifications



— Money at Fig. 1

See, e.g., '735 IPR Pet. 74-76; '735 IPR POR 64-70; '735 IPR Sur-Reply 24-26

Proposed Combination Fails to Teach "Electrically Receive"

For claims that require "electrically receiv[ing]" or "electrically convey[ing]" a signal from the pulse oximetry sensor, Sotera relied on Akai's fiber optic cable.

Limitation 20(e)	a cable extending from the pulse oximetry sensor and configured to electrically convey the first signal;

— '735 IPR Pet. at xviii (Claim 20 limitations)

e. Limitation 20(e)

Akai teaches the wired connection between the SpO_2 sensor and the CPU is a cable. EX1007, 5:14-19; EX1003, ¶291.

— '735 IPR Pet. 95

See, e.g., '735 IPR Pet. 95; '735 IPR POR 56-57

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Proposed Combination Fails to Teach "Electrically Receive"

- In Replies, Sotera argues that it "never suggested modifying Money to include Akai's *cable*." '735 IPR Reply 25

- But Petition expressly relied on Akai's cable:

> **e. Limitation 20(e)**
>
> Akai teaches the wired connection between the SpO_2 sensor and the CPU is a cable. EX1007, 5:14-19; EX1003, ¶ 291.

— '735 IPR Pet. 95

See, e.g., '735 IPR Pet. 95; '735 IPR Reply 25; '735 IPR Sur-Reply 23-24

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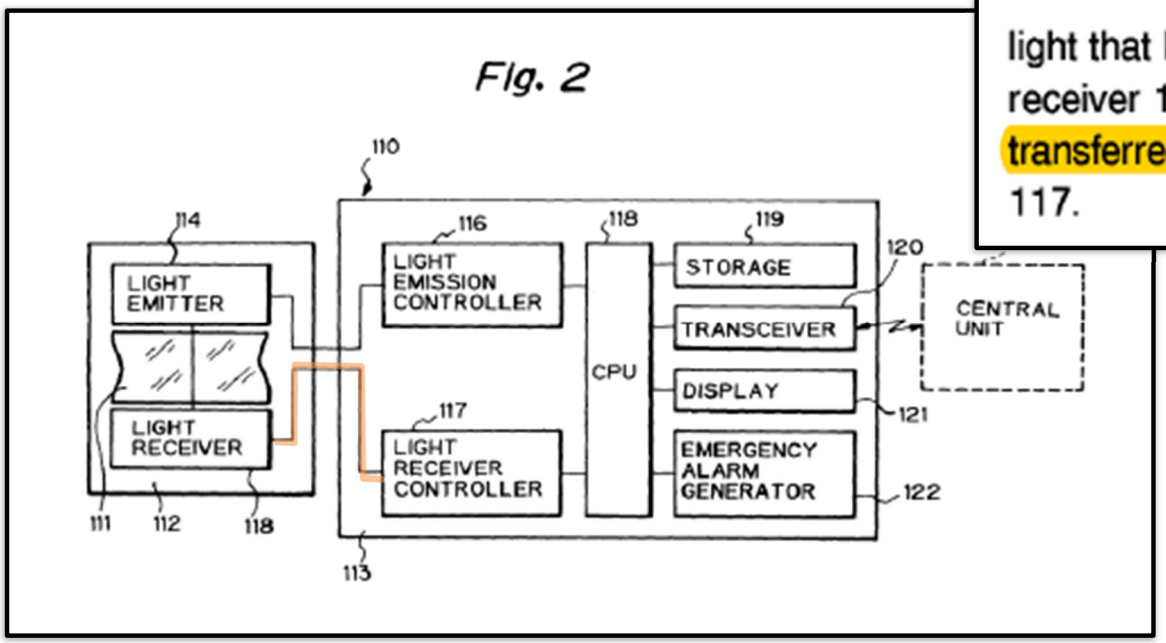
Proposed Combination Fails to Teach "Electrically Receive"

- Akai's sensor 112 would not work if the fiber optic cable is replaced with electrical wire.



. The light that has permeated finger 111 is received by light receiver 115 located at the other side of the finger and transferred via an optic fiber to controller of light receiver 117.

Note: Light receiver 115 is appears to be mislabeled as 118 in Akai's Fig. 2. '108 IPR Sur-Reply 25.

— Akai at Fig. 2, 5:26-30

See, e.g., '735 IPR Sur-Reply 23-24

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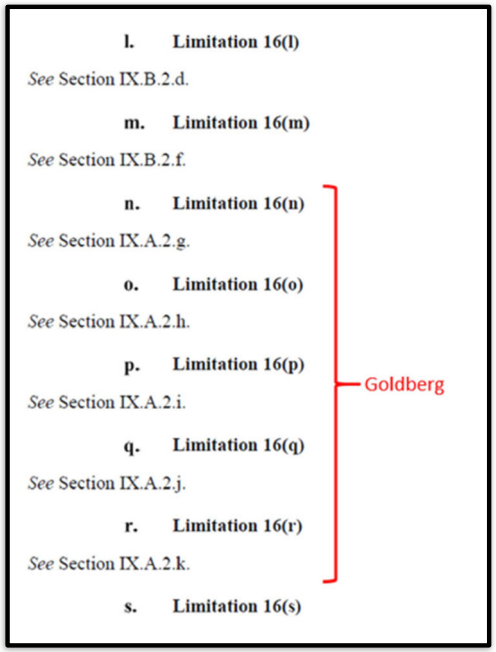
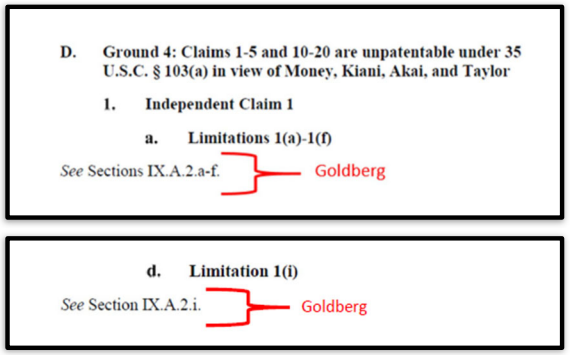
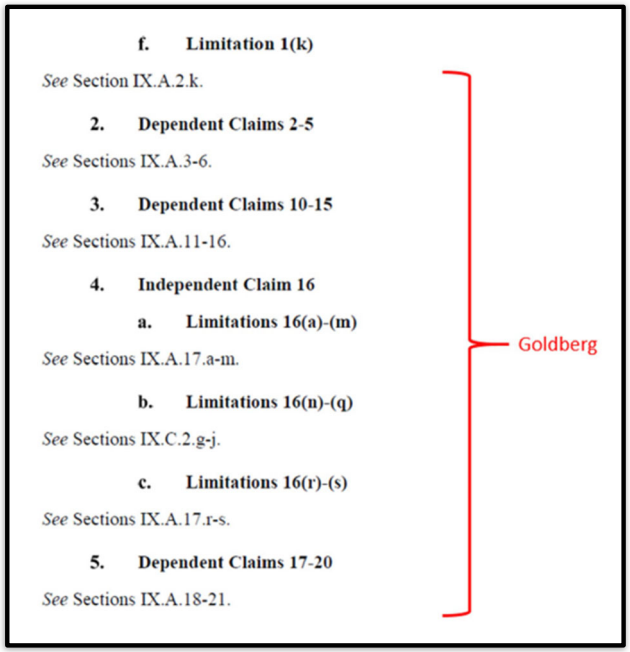
’300 IPR: Cross-References to the Wrong Reference

Sotera’s Money-based arguments are based on cross-references to Sotera’s Goldberg-based arguments.

- Petition fails to set forth a complete argument.

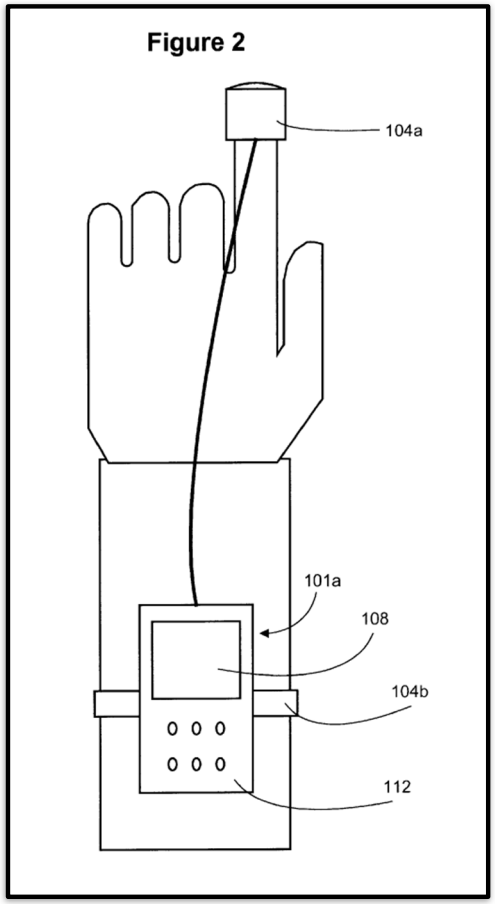






MISCELLANEOUS

Goldberg (EX1005)



Kiani (EX1006)

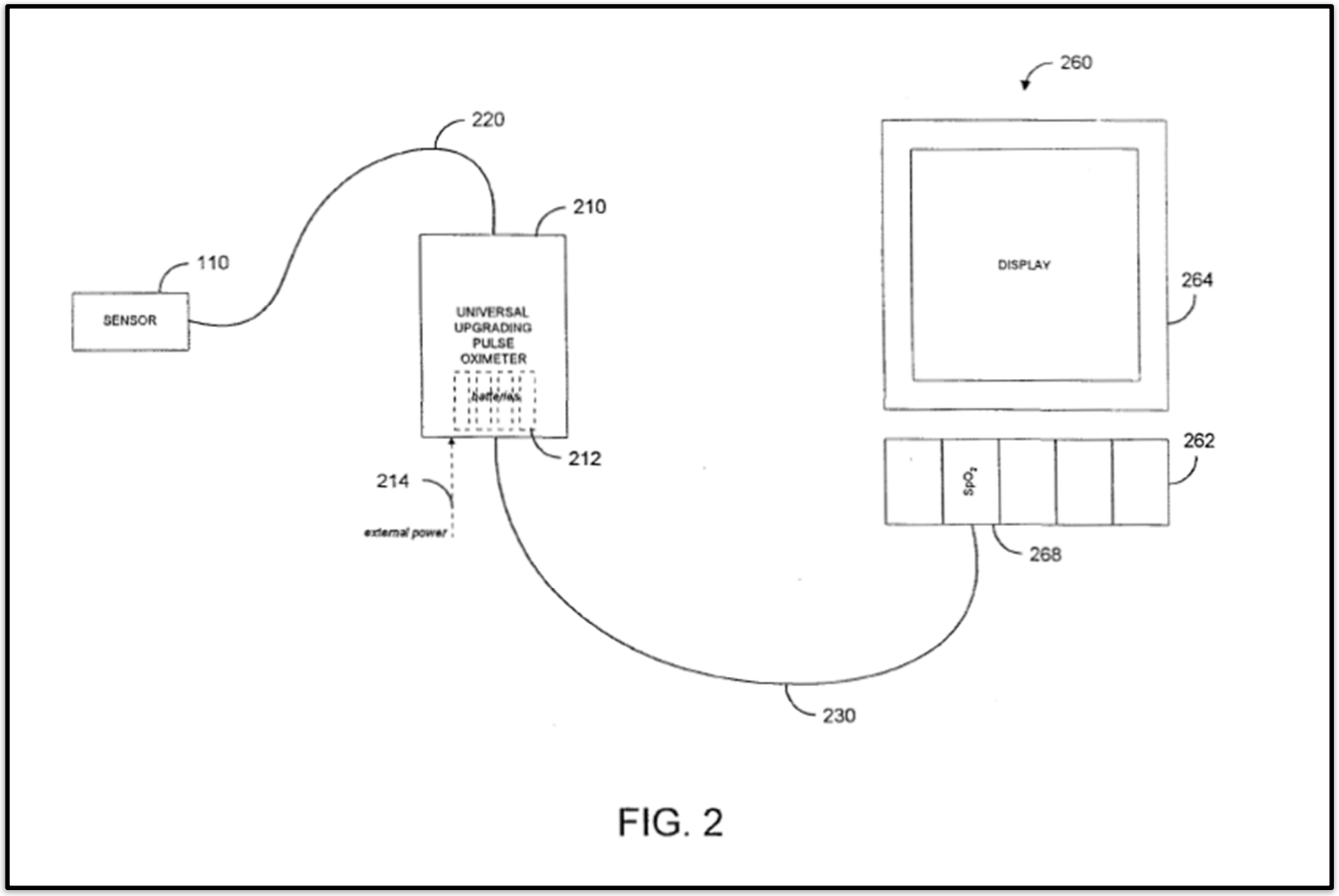
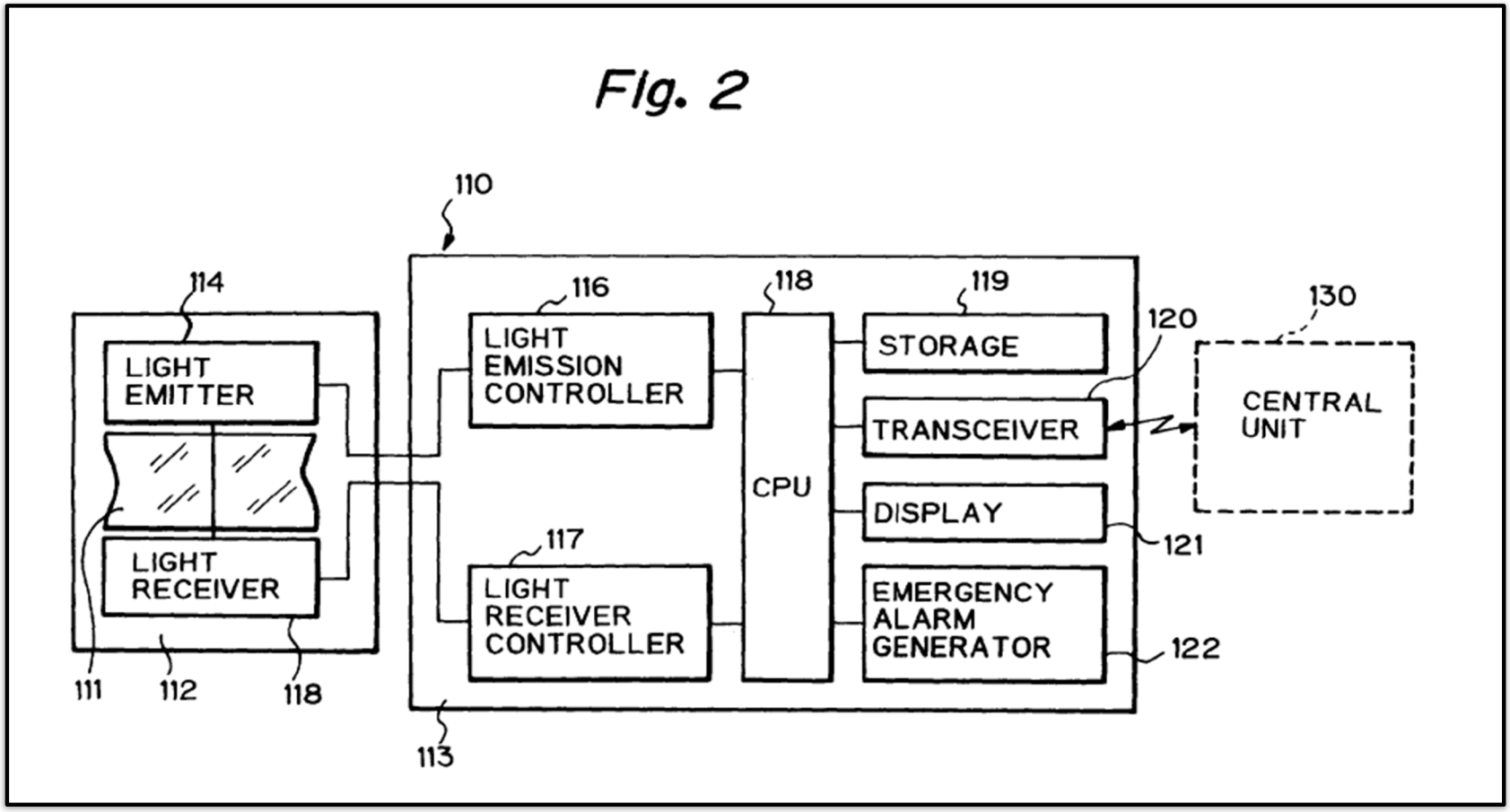
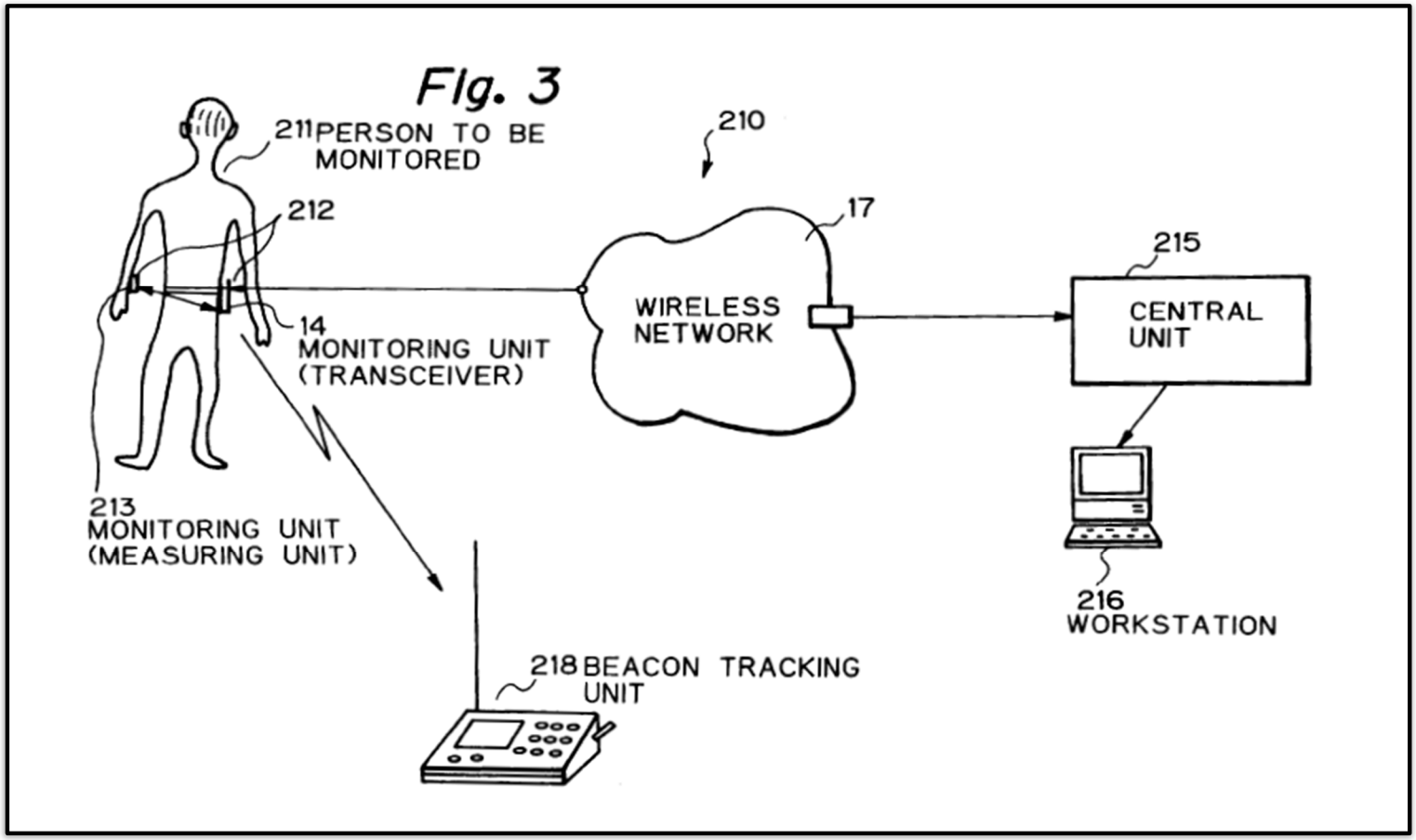


FIG. 2

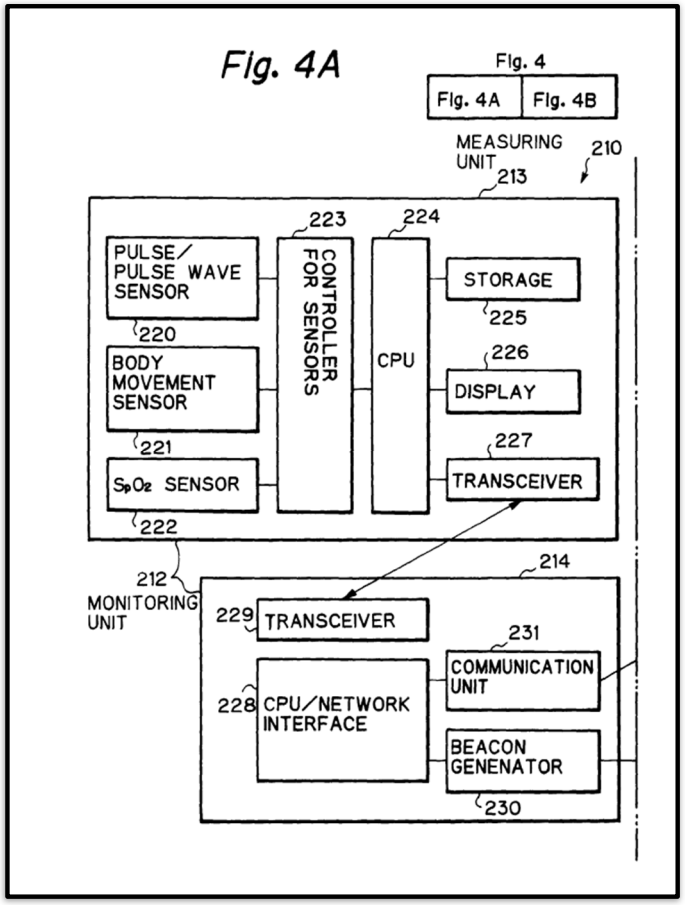
Akai (EX1007)

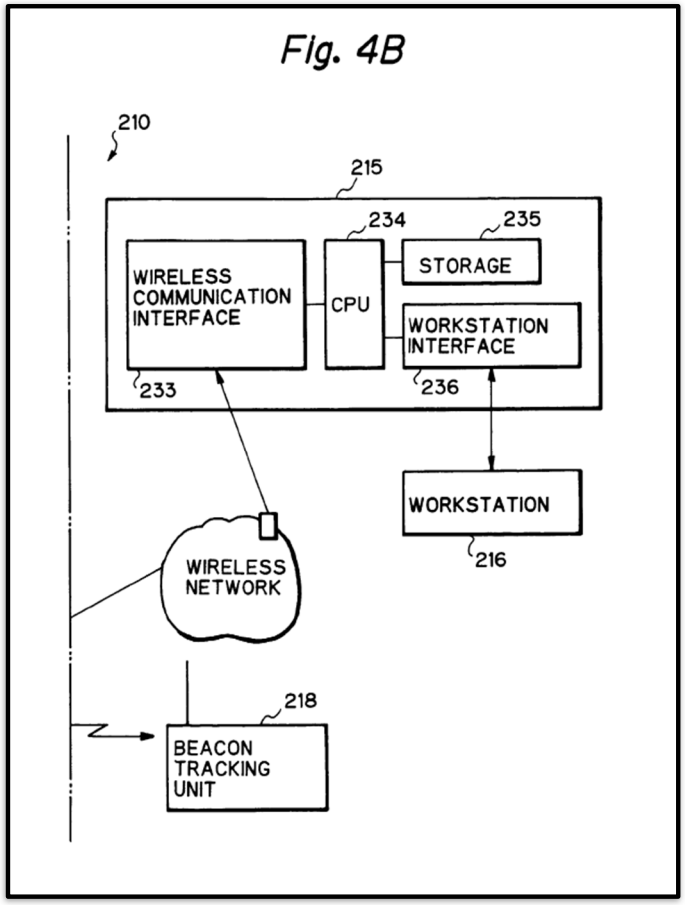


Akai (EX1007)



Akai (EX1007)





’108 Claim 1

1. An arm mountable portable patient monitoring device configured to receive physiological information from a plurality of sensors attached to a patient at at least two different measurement sites via wired connections for on-patient monitoring of parameter measurements and wireless transmission of parameter measurements to separate monitoring devices, the portable patient monitoring device comprising:

a housing configured to be secured to an arm of a patient under measurement;

a strap mountable to a back side of the housing and configured to secure the housing to the arm of the patient;

a display positioned on a front side of the housing, the display configured to show at least one status indicator of the portable patient monitoring device and one or more parameter measurements;

a first sensor port positioned on a first side of the housing, the first side of the housing configured to face toward a hand of the arm of the patient when the housing is secured to the arm of the patient, the first sensor port configured to electrically receive a signal from a pulse oximetry sensor via a wired connection from the pulse oximetry sensor to the first sensor port, the wired connection configured to extend from the first sensor port along a path substantially perpendicular to the first side of the housing;

a second sensor port positioned on the housing and configured to receive a signal from a second sensor arrangement via a wired connection;

a third sensor port positioned on the housing configured to receive a signal from a third sensor arrangement via a wired connection;

one or more signal processing arrangements configured to:

receive the signal from the pulse oximetry sensor; and

cause to be displayed, on the display, at least measurements of oxygen saturation and pulse rate derived from the signal; and

a transmitter configured to:

wirelessly transmit information indicative of the measurements of oxygen saturation and pulse rate to a separate monitoring device configured to receive the information indicative of the measurements of oxygen saturation and pulse rate.

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’108 Claim 17

17. A method of portable patient monitoring comprising:
providing a portable patient monitoring device according to claim **1**;
attaching the strap to the arm of the patient;
mounting the housing to the strap such that the first sensor port positioned on a first side of the housing faces toward the hand of the arm of the patient;
wrapping the pulse oximetry sensor around a digit of the hand of the patient;
attaching the wired connection from the pulse oximetry sensor to the first sensor port positioned on the first side of the housing; and
activating the portable patient monitoring device such that measurements of oxygen saturation and pulse rate are both:
displayed on the display of the portable patient monitoring device on the patient; and
wirelessly transmitted to the separate monitoring device configured to receive the measurements of oxygen saturation and pulse rate.

’108 Claim 19

19. An arm mountable portable patient monitoring device configured to receive physiological information from a plurality of sensors attached to a patient at at least two different measurement sites via wired connections for on-patient monitoring of parameter measurements and wireless transmission of parameter measurements to separate monitoring devices, the portable patient monitoring device comprising:

a housing configured to be secured to an arm of a patient under measurement, the housing comprising a front side including a single user interface, the single user interface comprising a display configured to show at least one or more parameter measurements;

a strap mountable to a back side of the housing and configured to secure the housing to the arm of the patient;

a first sensor port positioned on a first side of the housing, the first side of the housing configured to face toward a hand of the arm of the patient when the housing is secured to the arm of the patient, the first sensor port configured to electrically receive a signal from a pulse oximetry sensor via a wired connection from the pulse oximetry sensor to the first sensor port, the signal from the pulse oximetry sensor including analog information;

a second sensor port positioned on the housing and configured to receive a signal from a second sensor arrangement via a wired connection, the signal from the second sensor arrangement including digital information;

a third sensor port positioned on the housing configured to receive a signal from a third sensor arrangement via a wired connection;

one or more signal processing arrangements configured to:

receive the signal from the pulse oximetry sensor including the analog information;

receive the signal from the second sensor arrangement including the digital information;

determine digital transmit information based at least in part on: the analog information included in the signal from the pulse oximetry sensor, and the digital information included in the signal from the second sensor arrangement; and

cause to be displayed, on the display, at least measurements of oxygen saturation and pulse rate derived from the signal from the pulse oximetry sensor; and

a transmitter configured to:

wirelessly transmit the digital transmit information to a separate monitoring device configured to receive the digital transmit information, wherein the digital transmit information includes at least measurements of oxygen saturation and pulse rate derived from the signal from the pulse oximetry sensor, and wherein the digital transmit information further includes at least physiological measurements derived from the

’735 Claim 1

1. A body worn mobile medical monitoring device configured to minimize cable wiring from a sensor by placement of one or more sensor communication ports, the mobile medical monitoring device comprising:

a housing configured to be secured on a lower arm of a patient being monitored via a strap extending around the lower arm of the patient;

a display positioned on a face of the housing, opposite the strap, so as to be visible to a user;

a first sensor communication port positioned on a side of the housing and configured to face a hand of the lower arm of the patient when the mobile medical monitoring device is mounted to the lower arm of the patient, wherein:

the side of the housing faces the hand of the lower arm of the patient of the patient when the mobile medical monitoring device is mounted to the lower arm of the patient,

the first sensor communication port is configured to provide wired communication with a pulse oximetry sensor attached to a digit of the hand of the patient,

the wired communication with the pulse oximetry sensor provided at least partly in the analog domain, and

the first sensor communication port is positioned on the side of the housing such that a path from the first sensor communication port on the side of the housing to the digit of the patient is substantially perpendicular to the side of the housing and shorter than any other path from any other side of the housing to the digit of the patient;

a plurality of additional sensor communications ports positioned on the housing and configured to provide wired communication with a plurality of additional physiological sensors at least partly in the digital domain; and

one or more processors and a transmitter configured to:

display, on the display, physiological measurements derived from the pulse oximetry sensor and the plurality of additional physiological sensors; and

wirelessly transmit information indicative of the physiological measurements to a remote computing device.

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’735 Claim 13

13. A body worn, battery-powered medical monitoring device configured to provide on-patient and remote monitoring of patient physiological parameters, the medical monitoring device comprising:

a battery configured to provide power to the medical monitoring device such that the medical monitoring device may operate without a wired power connection;

a case configured to house the battery;

a strap configured to attach the case to an arm of a patient and be mountable to the case;

a first communications port positioned on a face of a side of the case configured to be nearest to a hand of the arm of the patient when the case is mounted to the arm of the patient, the first communications port configured to removably couple with a cable of a finger- or thumb-type pulse oximetry sensor and positioned on the face of the side of the case to provide a path from the first communications port to a digit of the hand of the patient that avoids tangling of the cable, the first communications port configured such that the cable perpendicularly extends from the face of the side of the case when the cable is coupled to the first communications port;

a second communications port configured to provide wired communications with a second physiological sensor arrangement at least partly via digital communications;

a third communications port configured to provide wired communications with a third physiological sensor arrangement;

a display configured to provide real time measurements of patient physiological parameters based at least in part on data obtained from at least the pulse oximetry sensor via the first communications port; and

a transmitter configured to wirelessly transmit information indicative of real time measurements of patient physiological parameters based at least in part on data obtained from the pulse oximetry sensor via the first communications port.

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’735 Claim 20

20. A body worn portable patient monitoring device configured to provide on-patient and remote monitoring of patient physiological parameters, the portable patient monitoring device comprising:

a pulse oximetry sensor configured to be wrapped around a digit of a patient, the pulse oximetry sensor including at least:

a light emitter configured to emit light into a tissue site of the digit of the patient;

a light detector configured output a first signal responsive to at least a portion of the emitted light after attenuation by tissue of the tissue site; and

a cable extending from the pulse oximetry sensor and configured to electrically convey the first signal;

a blood pressure sensor configured to output a second signal responsive to at least a blood pressure parameter of the patient;

an additional sensor arrangement configured to output a third signal responsive to at least one additional physiological parameter of the patient other than blood pressure or oxygen saturation, the at least one additional physiological parameter including at least one of: temperature or respiration rate;

a housing configured to be secured to a lower arm of the patient, the housing having a size and shape configured to be secured to the lower arm of the patient;

a strap mountable to the back side of the housing, the strap configured to secure the housing to the lower arm of the patient;

a display positioned on a front side of the housing that is opposite a back side of the housing, the display configured to show a status of the portable patient monitoring device and one or more parameter measurements so as to be viewable by a user, wherein the display is positioned centrally on the front side of the display and is sized such that the display spans most of a length of a shortest dimension of the front side of the housing, and wherein the front side of the housing comprises a single user interface and a bezel;

one or more user input mechanisms configured to control an operational mode of the portable patient monitoring device in response to inputs from a user;

a first sensor port positioned on a face of a first side of the housing, wherein:

the face of the first side of the housing is configured to face toward a hand having the digit of the patient under measurement when the housing is secured to the lower arm of the patient,

the first sensor port is configured to removably physically couple with the pulse oximetry sensor via the cable and to electrically receive the first signal from the pulse oximetry sensor,

the cable is configured to run from the first sensor port, at least part way along a path substantially perpendicular to the face of the first side of the housing, down the arm of the patient, and to the digit of the patient to which the pulse oximetry sensor is configured to be wrapped around,

the front side of the housing is raised from the strap and the lower arm of the patient to enable positioning of the first sensor port on the first side of the housing between the lower arm of the patient and the front side of the housing, and

a top of the first sensor port is located below the front of the housing;

a second sensor port positioned on the housing and configured to provide wired electrical communication with the blood pressure sensor arrangement and to electrically receive second signal from the blood pressure sensor arrangement;

a third sensor port positioned on the housing and configured to provide electrical wired communication with the additional sensor arrangement and to electrically receive the third signal from the additional sensor arrangement;

a rechargeable battery positioned within the housing and configured to power the portable patient monitoring device such that the portable patient monitoring device is portable and wearable by the patient;

one or more signal processing arrangements positioned within the housing and configured to:

receive the first signal from the pulse oximetry sensor via one or more sensor interfaces, wherein the first signal is provided at least partly as an analog signal;

process the first signal from the pulse oximetry sensor to determine measurements of oxygen saturation and pulse rate;

receive the second signal from the blood pressure sensor arrangement via the one or more sensor interfaces, the second signal responsive to at least a blood pressure parameter of the patient;

receive the third signal from the additional sensor arrangement via the one or more sensor interfaces, the third signal responsive to the at least one additional physiological parameter of the patient including at least one of: temperature or respiration rate, wherein the third signal is provided at least partly as a digital signal; and

cause the measurements of oxygen saturation, pulse rate, blood pressure, and the at least one additional physiological parameter to all be displayed on the display of the portable patient monitoring device; and

a transmitter positioned within the housing and configured to:

wirelessly transmit a transmit signal including the information indicating the measurements of oxygen saturation, pulse rate, blood pressure, and the at least one additional physiological parameter to a separate computing device configured to display, on a remote display, the measurements of oxygen saturation, pulse rate, blood pressure, and the at least one additional physiological parameter.

’300 Claim 1

1. A wearable, portable physiological monitor configured to wirelessly transmit real time information regarding a plurality physiological parameters, the portable monitor comprising:

a plurality of sensor ports positioned on a housing of the portable monitor and configured to provide respective wired interfaces with different respective physiological sensors of a plurality of physiological sensors, wherein:

at least a first sensor port of the plurality of sensor ports is positioned on a side of the housing of the portable monitor such that, when the portable monitor is attached to an arm of a patient, a wired connection extending from the first sensor port to a first physiological sensor positioned on a digit of the patient follows a path to the digit of the patient that is substantially perpendicular to the side of the housing and avoids tangling of the wired connection;

one or more processing devices configured to:

receive, via the plurality of sensor ports, a plurality of signals from the plurality of physiological sensors, at least some of the plurality of signals including digital information, and at least some of the plurality of signals including analog information;

cause to be displayed, on a display of the portable monitor, a plurality of physiological parameters values responsive to the plurality of signals;

combine information indicative of the plurality of signals into a single digital word or bit stream; and

encode the single digital word or bit stream to generate a baseband signal; and

a transmitter configured to:

modulate the baseband signal with a carrier to generate a transmit signal; and

wirelessly transmit the transmit signal to a remote patient monitoring device configured to decode the signal and display, on a remote display, the plurality of physiological parameters values responsive to the plurality of signals.

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’300 Claim 16

16. A battery-powered wearable physiological monitoring device configured to communicate with multiple types of sensor arrangements via a plurality of sensor interfaces, the wearable physiological monitoring device comprising:

a plurality of sensor communication ports including:

a first sensor communication port configured to provide wired communication with a first type of physiological sensor arrangement, wherein the first sensor port is positioned on the device such that a wire extending from the first sensor communication port to the first type of physiological sensor arrangement extends from the device along an axis perpendicular to a face of the device upon which the first sensor port is positioned;

a second sensor communication port configured to provide wired communication with a second type of physiological sensor arrangement different from the first type of physiological sensor arrangement; and

a third sensor communication port configured to provide wired communication with a third type of physiological sensor arrangement different from both the first and second types of physiological sensor arrangements;

a plurality of sensor interfaces including:

a first sensor interface configured to receive a first signal from a first sensor arrangement of the first type, the first signal including analog information;

a second sensor interface configured to receive a second signal from a second sensor arrangement of the second type the second signal including digital information; and

a third sensor interface configured to receive a third signal from a third sensor arrangement of the third type;

wherein the plurality of sensor interfaces are configured to output one or more signals indicative of physiological parameters sensed by the first, second, and third sensor arrangements;

a display positioned on a face of the wearable physiological monitoring device configured to display information while the wearable physiological monitoring device is being worn by a patient;

a processor configured to:

responsive to the one or more signals indicative of the physiological parameters, cause to be displayed, on the display, physiological parameter measurements;

combine information indicative of the one or more signals into a single digital word or bit stream; and

encode the single digital word or bit stream to generate a baseband signal;

a transmitter configured to:

modulate the baseband signal with a carrier to generate a transmit signal; and

wirelessly transmit the transmit signal to a receiving patient monitoring device that is not wired to the wearable physiological monitoring device; and

a battery configured to provide power to at least the processor, the display, the transmitter, and the first sensor arrangement via the first sensor communication port such that the wearable physiological monitoring device is portable and wearable by a patient.

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’623 Claim 1

1. An arm mountable portable patient monitoring device configured for both on-patient monitoring of parameter measurements using one or more sensors operatively connected to the portable patient monitoring device and wireless transmission of parameter measurements, the portable patient monitoring device comprising:

a pulse oximetry sensor configured to be wrapped around a digit of a patient, the pulse oximetry sensor including at least:

a light emitter configured to emit light into a tissue site of the digit of the patient;

a light detector configured output a signal responsive to at least a portion of the emitted light after attenuation by tissue of the tissue site; and

a tail configured to electrically convey the signal;

a housing configured for, and having a size and shape configured for, mounting to a lower arm of the patient, the housing including at least:

a display positioned on a front side of the housing that is opposite a back side of the housing, the display configured to show a status of the portable patient monitoring device and one or more parameter measurements so as to be viewable by a user;

a first sensor port positioned on a first side of the housing, the first side of the housing configured to face toward a hand having the digit of the patient under measurement, the first sensor port configured to physically couple to the tail of the pulse oximetry sensor and to electrically receive the signal from the pulse oximetry sensor, wherein the first sensor port is positioned on the first side of the housing such that, when the tail is physically coupled to the first sensor port, the tail extends from the first sensor port along an axis perpendicular to a face of the first side of the housing on which the first sensor port is positioned;

a second sensor port configured to receive information from an EKG sensor arrangement via a wired connection;

a third sensor port configured to receive information from a blood pressure sensor arrangement via a wired connection;

a rechargeable battery configured to power the portable patient monitoring device including the pulse oximetry sensor;

one or more signal processing arrangements configured to:

receive the signal from the pulse oximetry sensor;

derive, based on the signal, measurements of oxygen saturation and pulse rate; and

cause to be displayed, on the display, the measurements of oxygen saturation and pulse rate; and

a transmitter configured to:

wirelessly transmit a transmit signal indicative of the measurements of oxygen saturation and pulse rate to a separate computing device configured to display the measurements of oxygen saturation and pulse rate; and

a strap mountable to the back side of the housing, the strap configured to secure the housing to the lower arm of the patient.

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’623 Claim 17

17. An arm mountable portable patient monitoring device configured for both on-patient monitoring of parameter measurements using one or more sensors operatively connected to the portable patient monitoring device and wireless transmission of parameter measurements, the portable patient monitoring device comprising:

a pulse oximetry sensor configured to be wrapped around a digit of a patient, the pulse oximetry sensor including at least:

a light emitter configured to emit light into a tissue site of the digit of the patient; and

a light detector configured output a signal responsive to at least a portion of the emitted light after attenuation by tissue of the tissue site;

a housing configured to be mounted to an arm of the patient, the housing including at least:

a display positioned on a front side of the housing that is opposite a back side of the housing, the display configured to show a status of the portable patient monitoring device and one or more parameter measurements so as to be viewable by a user;

a first sensor port positioned on a first side of the housing, the first side of the housing having a face that is configured to face toward a hand having the digit of the patient under measurement, the first sensor port configured to electrically receive the signal from the pulse oximetry sensor via a wire extending from the pulse oximetry sensor to the first sensor port, wherein the wire extends from the first sensor port perpendicularly to the face of the first side of the housing;

second and third sensor ports configured to receive signals from two or more additional sensor arrangements via wired communications;

a rechargeable battery configured to power the portable patient monitoring device including the pulse oximetry sensor;

one or more signal processing arrangements configured to:

receive the signal from the pulse oximetry sensor; and

cause to be displayed, on the display, measurements of oxygen saturation and pulse rate derived from the received signal; and

a transmitter configured to:

wirelessly transmit a transmit signal indicative of the measurements of oxygen saturation and pulse rate to a separate computing device configured to display the measurements of oxygen saturation and pulse rate; and

a strap mountable to the back side of the housing, the strap configured to secure the housing to the arm of the patient.

’623 Claim 20

20. An arm mountable portable patient monitoring device configured for both on-patient monitoring of parameter measurements using one or more sensors operatively connected to the portable patient monitoring device and wireless transmission of parameter measurements, the portable patient monitoring device comprising:

a pulse oximetry sensor configured to be wrapped around a digit of a patient, the pulse oximetry sensor including at least:

a light emitter configured to emit light into a tissue site of the digit of the patient;

a light detector configured output a first signal responsive to at least a portion of the emitted light after attenuation by tissue of the tissue site; and

a cable extending from the pulse oximetry sensor and configured to electrically convey the first signal;

a blood pressure sensor configured to output a second signal responsive to at least a blood pressure parameter of the patient;

an additional sensor arrangement configured to output a third signal responsive to at least one additional physiological parameter of a patient other than blood pressure or oxygen saturation, the at least one additional physiological parameter including at least one of: temperature or respiration rate;

a housing configured to be secured to a lower arm of the patient, the housing having a size and shape configured to be secured to the lower arm of the patient;

a strap mountable to the back side of the housing, the strap configured to secure the housing to the lower arm of the patient;

a display positioned on a front side of the housing that is opposite a back side of the housing, the display configured to show a status of the portable patient monitoring device and one or more parameter measurements so as to be viewable by a user, wherein the display is positioned centrally on the front side of the display and is sized such that the display spans most of a length of a shortest dimension of the front side of the housing, and wherein the front side of the housing comprises a single user interface and a bezel;

one or more user input mechanisms configured to control an operational mode of the portable patient monitoring device in response to inputs from a user;

a first sensor port positioned on a first side of the housing, wherein:

the first side of the housing is configured to face toward a hand having the digit of the patient under measurement when the housing is secured to the lower arm of the patient,

the first sensor port is configured to removably physically couple with the pulse oximetry sensor via the cable and to electrically receive the first signal from the pulse oximetry sensor,

the cable is configured to run from the first sensor port, at least part way down the arm of the patient, and to the digit of the patient to which the pulse oximetry sensor is configured to be wrapped around,

the first sensor port is positioned on the first side of the housing such that, when the cable is physically coupled to the first sensor port, the cable extends from the first sensor port along a path perpendicular to the first side of the housing on which the first sensor port is positioned,

the front side of the housing is raised from the strap and the lower arm of the patient to enable positioning of the first sensor port on the first side of the housing between the lower arm of the patient and the front side of the housing, and

a top of the first sensor port is located below the front of the housing;

a second sensor port positioned on the housing and configured to provide electrical communication with the blood pressure sensor arrangement and to electrically receive second signal from the blood pressure sensor arrangement, wherein the second sensor port is connectable to wire extending from the blood pressure sensor arrangement to provide the electrical communication with the blood pressure sensor arrangement;

a third sensor port positioned on the housing and configured to provide electrical communication with the additional sensor arrangement and to electrically receive the third signal from the additional sensor arrangement, wherein the third sensor port is connectable to wire extending from the additional sensor arrangement to provide the electrical communication with the additional sensor arrangement;

a rechargeable battery within the housing and configured to power the portable patient monitoring device including at least the pulse oximetry sensor such that the portable patient monitoring device is portable and wearable by the patient;

one or more signal processing arrangements within the housing and configured to:

receive the first signal from the pulse oximetry sensor via one or more sensor interfaces;

process the first signal from the pulse oximetry sensor to determine measurements of oxygen saturation and pulse rate, wherein the first signal is processed at least in part in the analog domain by at least one of: the one or more sensor interfaces, or the one or more signal processing arrangements;

receive the second signal from the blood pressure sensor arrangement via the one or more sensor interfaces, wherein the second signal is processed at least in part in the digital domain by at least one of: the one or more sensor interfaces, or the one or more signal processing arrangements;

receive the third signal from the additional sensor arrangement via the one or more sensor interfaces, wherein the third signal is processed at least in part in the digital domain by at least one of: the one or more sensor interfaces, or the one or more signal processing arrangements; and

cause the measurements of oxygen saturation, pulse rate, blood pressure, and the at least one additional physiological parameter to all be displayed on the display of the portable patient monitoring device;

a multiplexer within the housing and configured to combine at least information indicative of the measurements of oxygen saturation, pulse rate, blood pressure, and the at least one additional physiological parameter into a single digital word or bit stream;

an encoder within the housing and configured to encode the single digital word or bit stream to generate a baseband signal; and

a transmitter within the housing and configured to:

modulate the baseband signal with a carrier to generate a transmit signal; and

wirelessly transmit a transmit signal including the information indicating the measurements of oxygen saturation, pulse rate, blood pressure, and the at least one additional physiological parameter to a separate computing device configured to decode the transmit signal and display, on a remote display, the measurements of oxygen saturation, pulse rate, blood pressure, and the at least one additional physiological parameter.

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