US 20080071153A1

(19) United States
(12) Patent Application Publication (10) Pub. No.: US 2008/0071153 A1
Al-Ali et al. (43) Pub. Date: Mar. 20, 2008

(54) DUO CONNECTOR PATIENT CABLE

(76) Inventors: **Ammar Al-Ali**, Tustin, CA (US); **Yassir Abdul-Hafiz**, Irvine, CA (US); **Kevin Forest**, Rancho Santa Margarita, CA (US)

Correspondence Address:
KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET
FOURTEENTH FLOOR
IRVINE, CA 92614 (US)

(21) Appl. No.: 11/858,818

(22) Filed: Sep. 20, 2007

Related U.S. Application Data

(60) Provisional application No. 60/846,260, filed on Sep. 20, 2006.

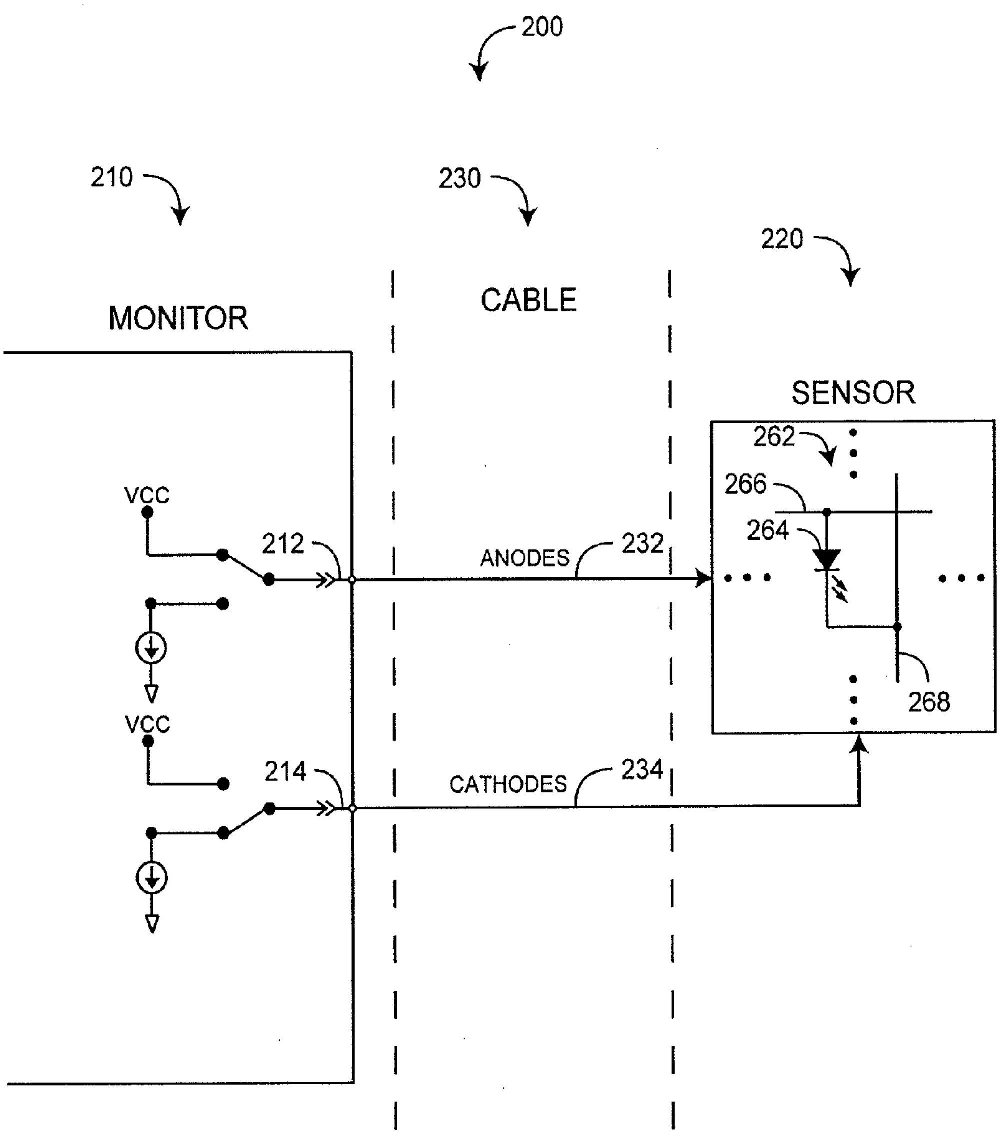
Publication Classification

(51) Int. Cl.
A61B 5/00 (2006.01)

(52) U.S. Cl. 600/310

(57) ABSTRACT

A patient cable has a duo sensor connector having a first socket section and a second socket section. The first socket section is configured to removably attach a two-wavelength sensor. The second socket section in conjunction with the first socket section is configured to removably attach a multiple wavelength sensor in lieu of the two-wavelength sensor. A circuit housed in the duo sensor connector converts emitter array drive signals adapted for the multiple wavelength sensor into back-to-back emitter drive signals adapted for the two-wavelength sensor when attached.



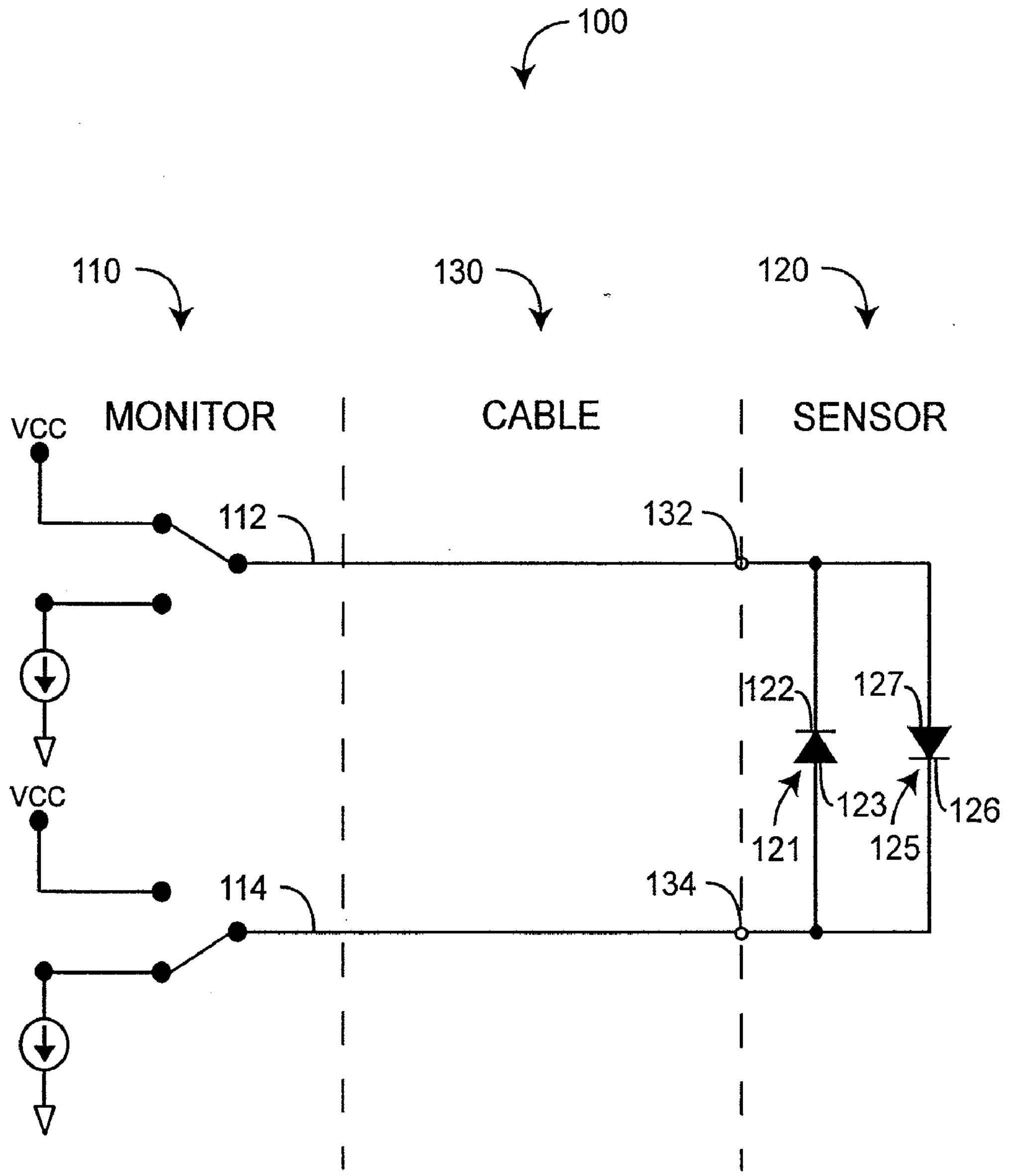


FIG. 1 (Prior Art)

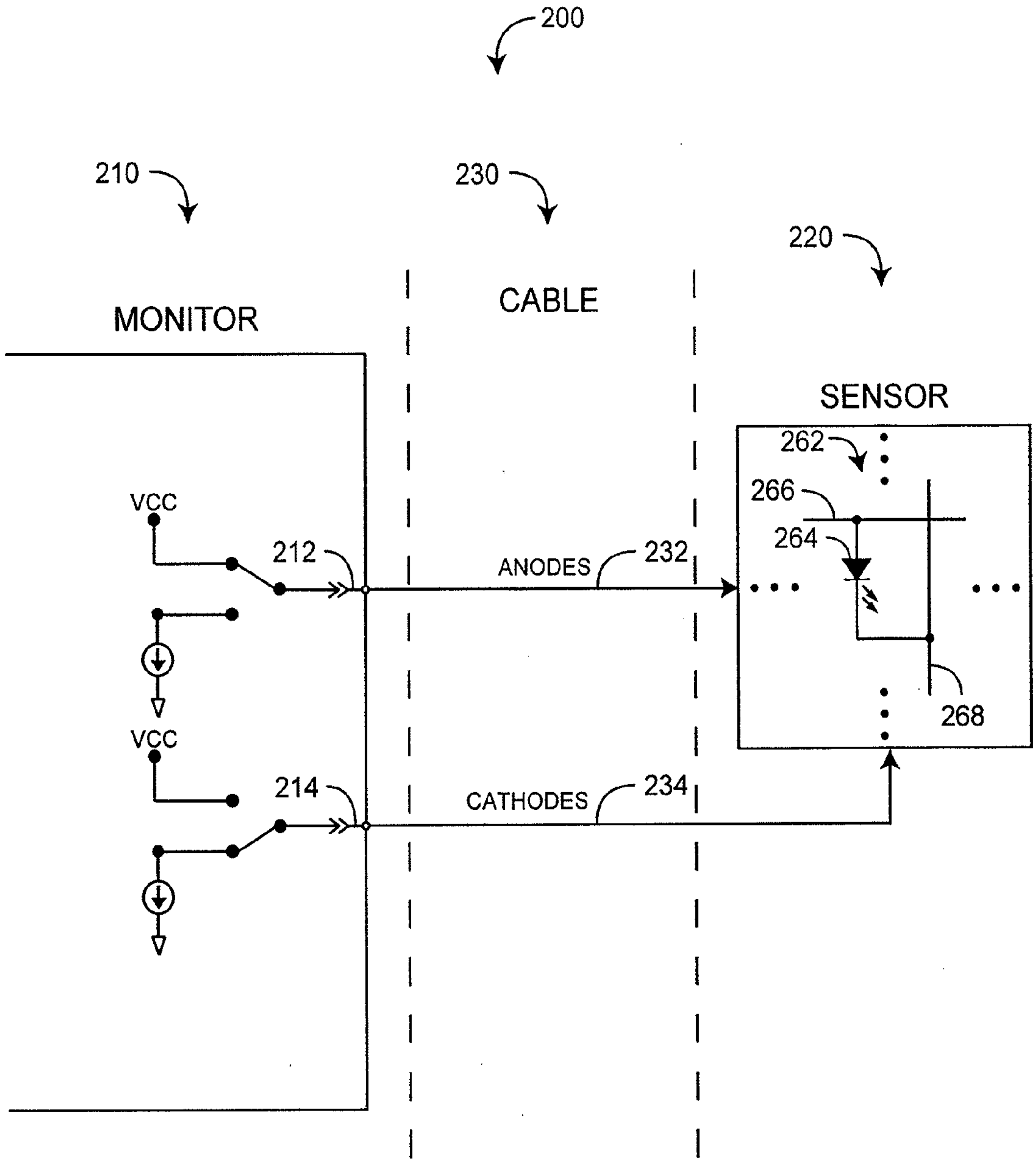
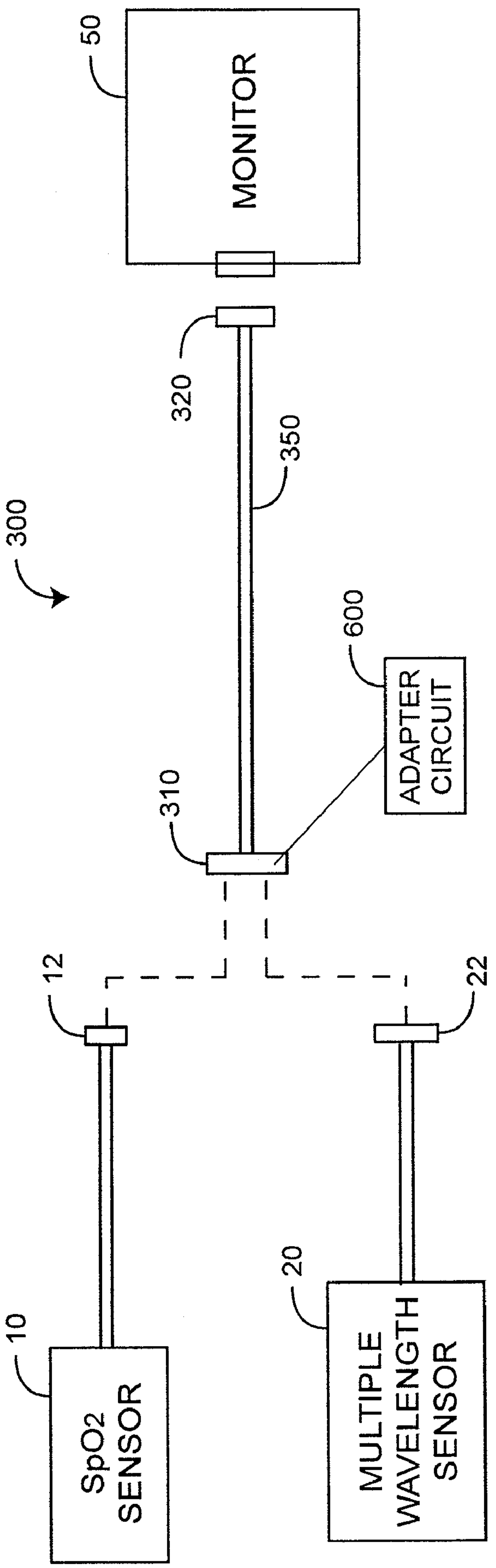

200
210
230
220
MONITOR
CABLE
SENSOR
VCC
212
ANODES
232
262
266
264
268
VCC
214
CATHODES
234

FIG. 2



MONITOR
50
320
350
300
600
ADAPTER CIRCUIT
310
12
22
SpO2 SENSOR
10
MULTIPLE WAVELENGTH SENSOR
20

FIG. 3A

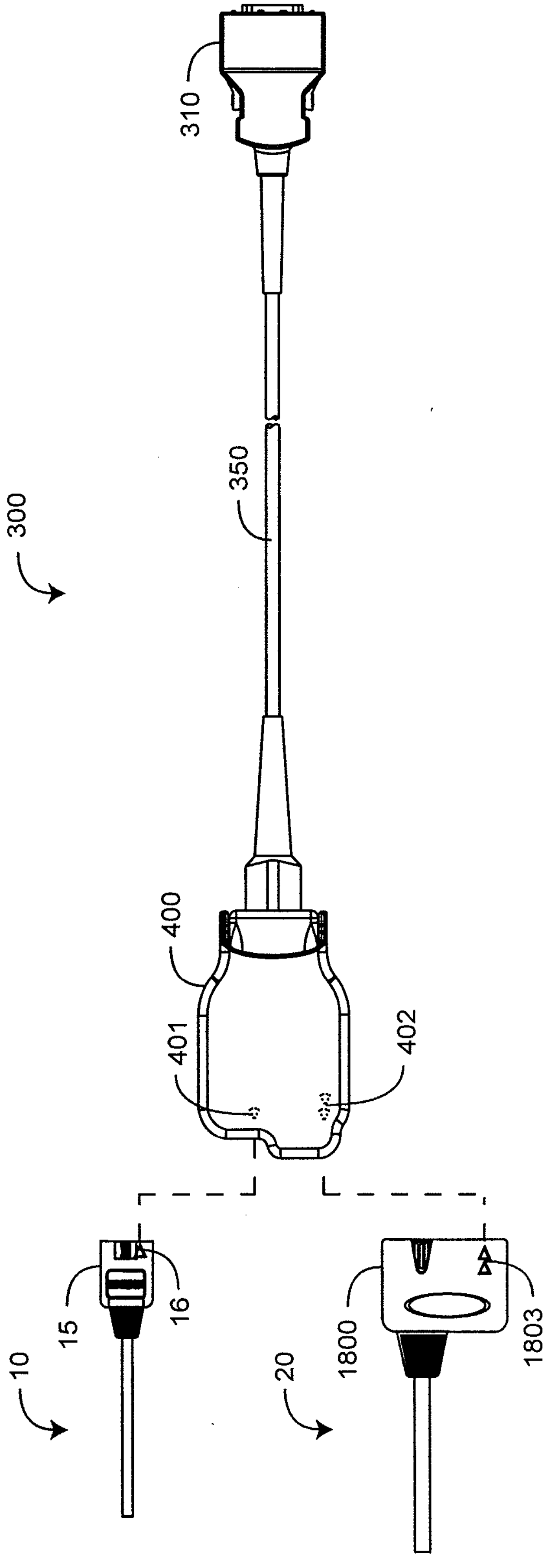
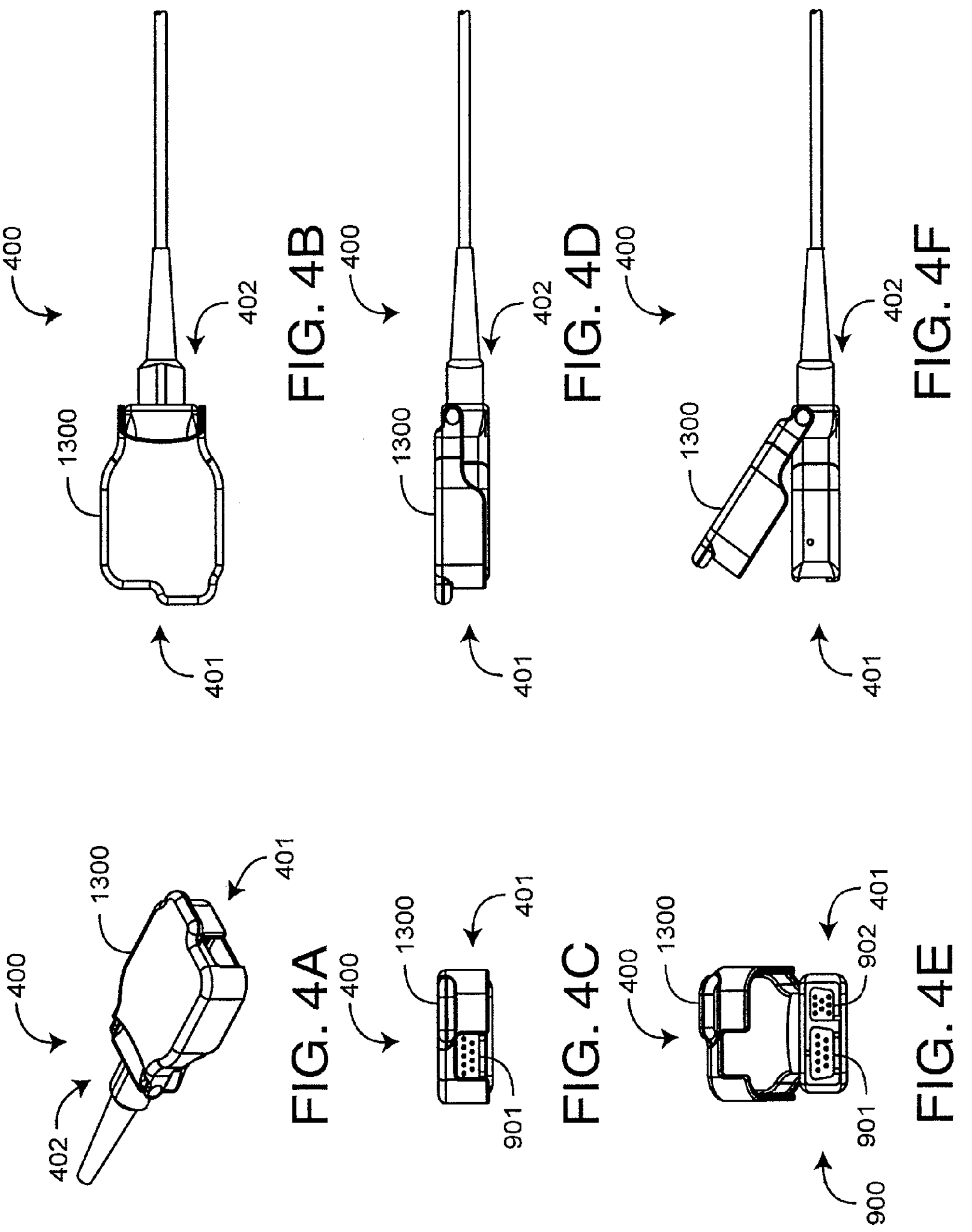


FIG. 3B


400
402
1300
401
FIG. 4B
400
402
1300
401
FIG. 4D
400
402
1300
401
FIG. 4F
400
1300
401
402
FIG. 4A
400
1300
401
901
FIG. 4C
400
1300
401
902
901
900
FIG. 4E

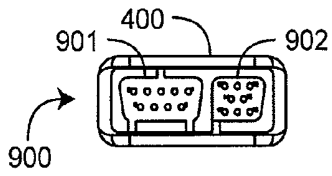


FIG. 5A

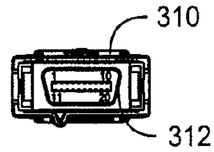


FIG. 5B

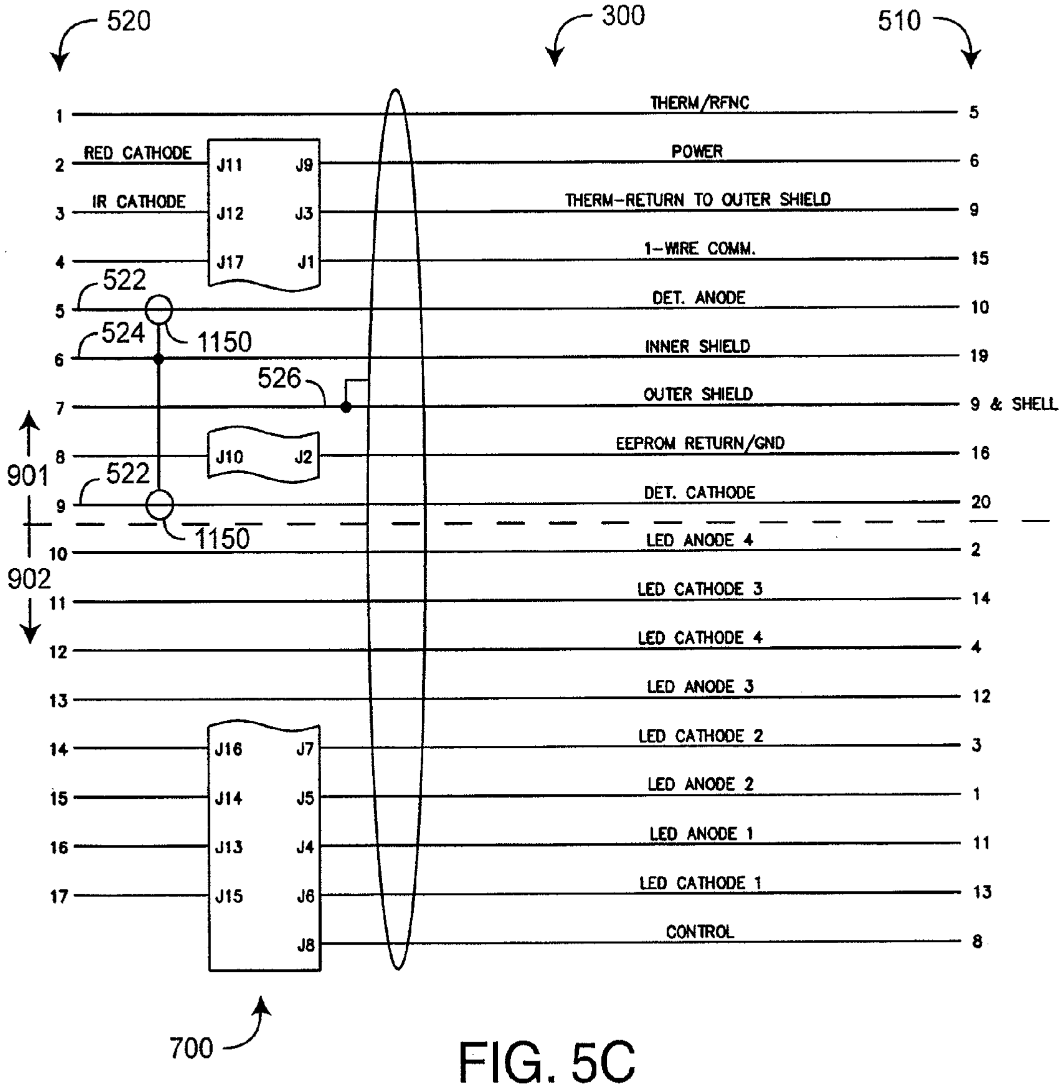


FIG. 5C

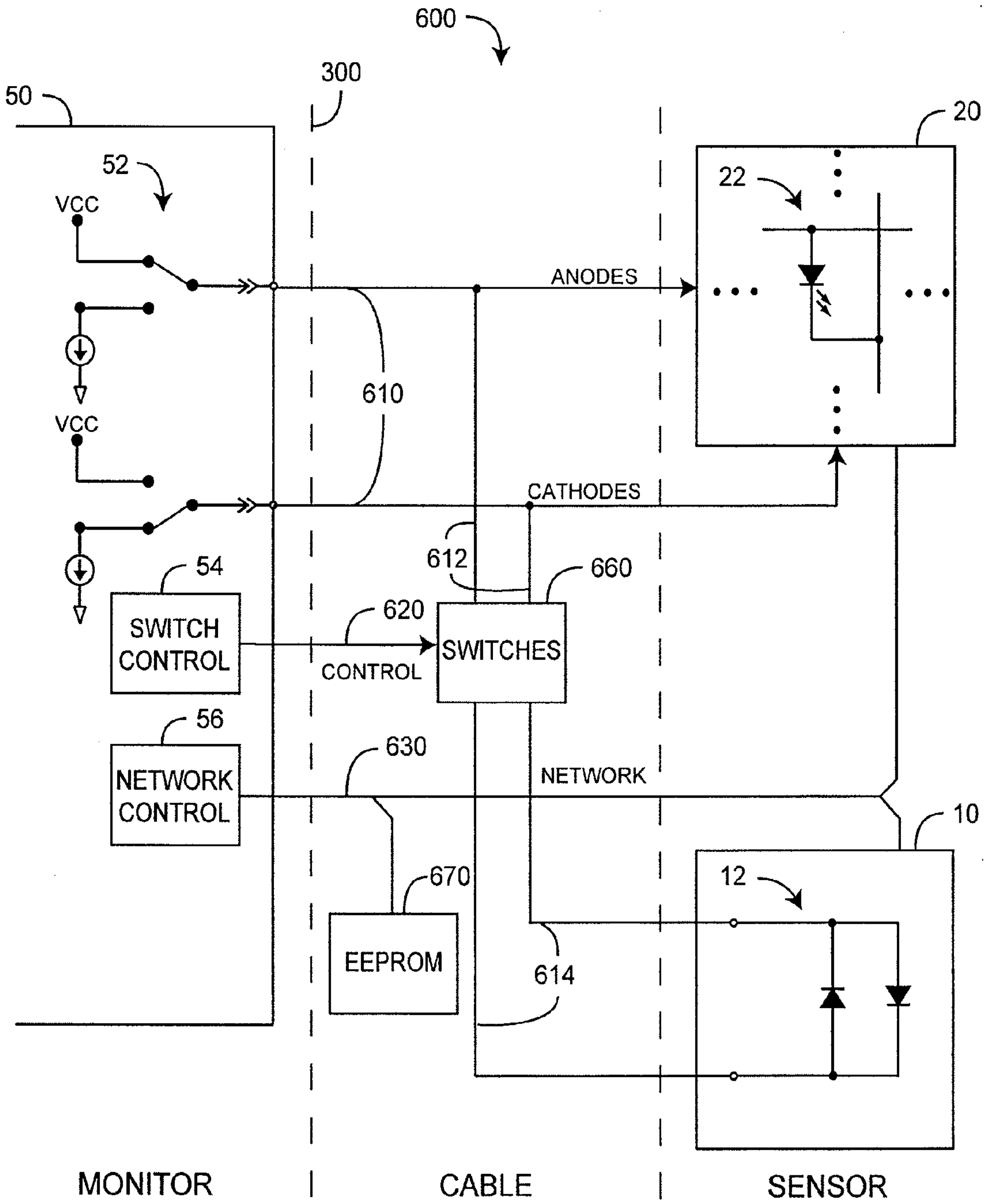
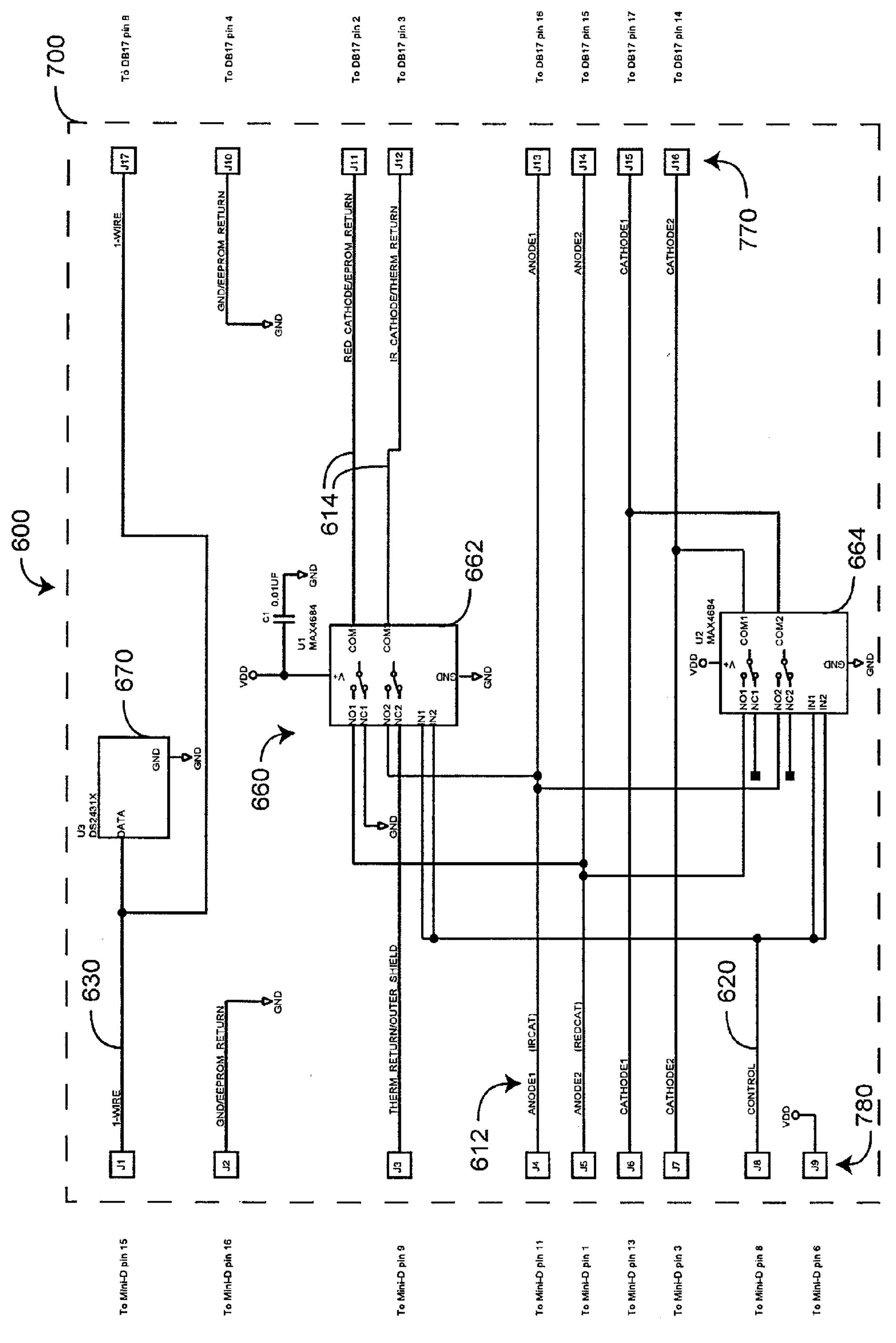

600
300
50
52
VCC
VCC
ANODES
CATHODES
610
612
20
22
54
SWITCH CONTROL
620
CONTROL
SWITCHES
660
56
NETWORK CONTROL
630
NETWORK
10
12
670
EEPROM
614
MONITOR
CABLE
SENSOR

FIG. 6



700
600
To DB17 pin 8
To DB17 pin 4
To DB17 pin 2
To DB17 pin 3
To DB17 pin 16
To DB17 pin 15
To DB17 pin 17
To DB17 pin 14
J17
J10
J11
J12
J13
J14
J15
J16
770
1-WIRE
GND/EEPROM RETURN
RED CATHODE/EPROM RETURN
IR CATHODE/THERM RETURN
ANODE1
ANODE2
CATHODE1
CATHODE2
GND
614
662
664
C1 0.01UF
U1 MAX4684
U2 MAX4684
VDD
COM
COM1
COM2
NO1
NC1
NO2
NC2
IN1
IN2
V+
670
U3 DS2431X
DATA
660
630
620
612
THERM RETURN/OUTER SHIELD
ANODE1 (IRCAT)
ANODE2 (REDCAT)
CONTROL
780
J1
J2
J3
J4
J5
J6
J7
J8
J9
To Mini-D pin 15
To Mini-D pin 16
To Mini-D pin 9
To Mini-D pin 11
To Mini-D pin 1
To Mini-D pin 13
To Mini-D pin 3
To Mini-D pin 8
To Mini-D pin 6

FIG. 7A

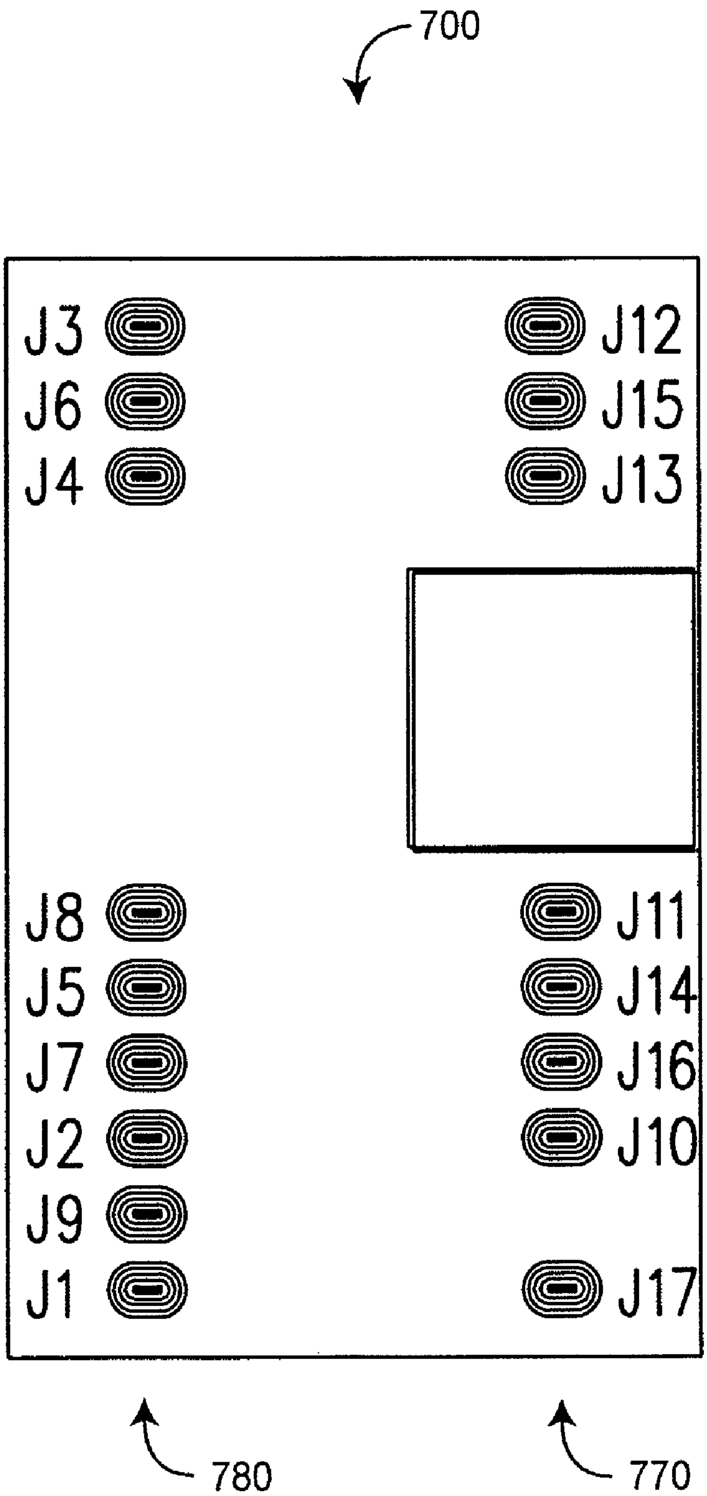

700
J3
J6
J4
J12
J15
J13
J8
J5
J7
J2
J9
J1
J11
J14
J16
J10
J17
780
770

FIG. 7B

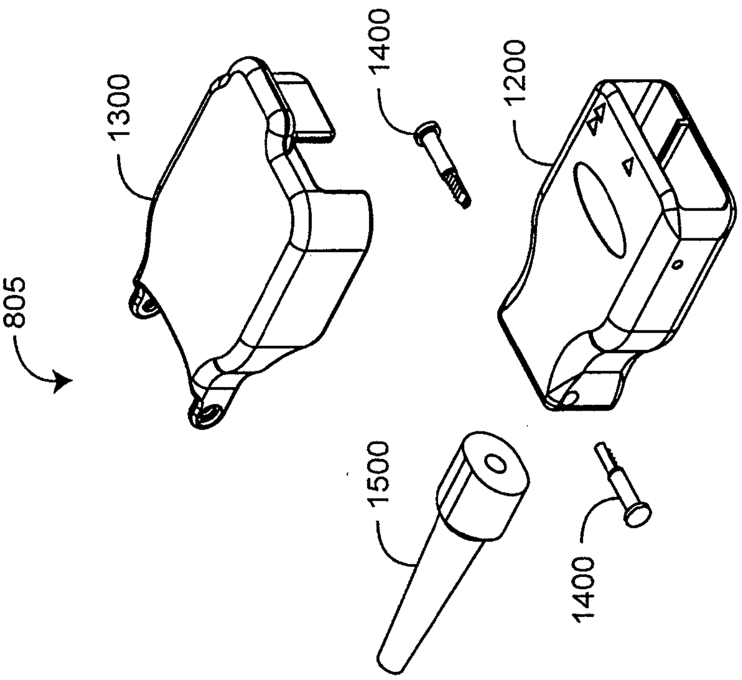


FIG. 8C

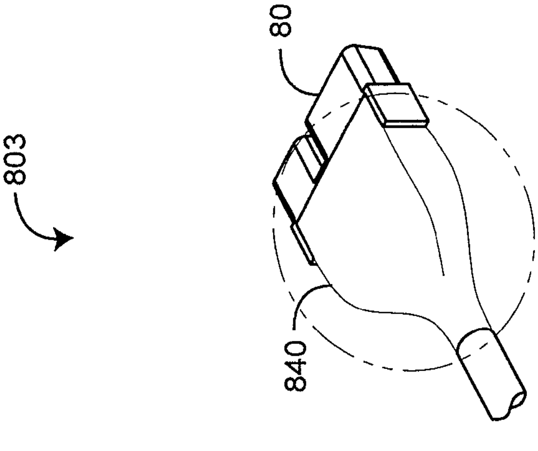


FIG. 8B

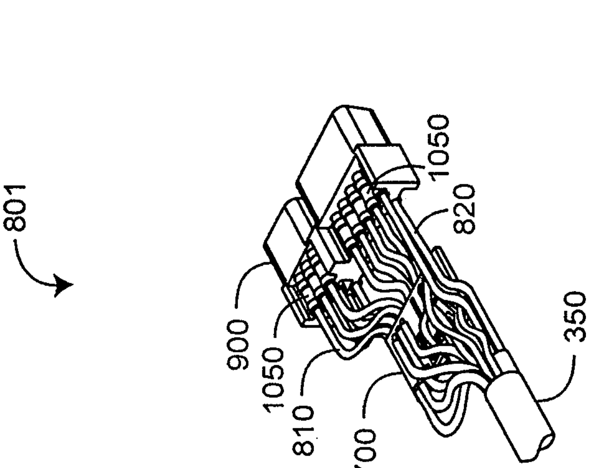


FIG. 8A

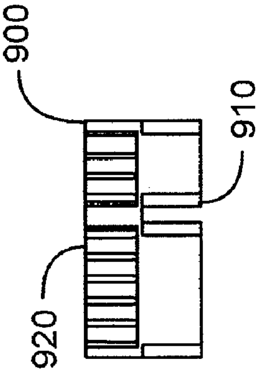


FIG. 9A

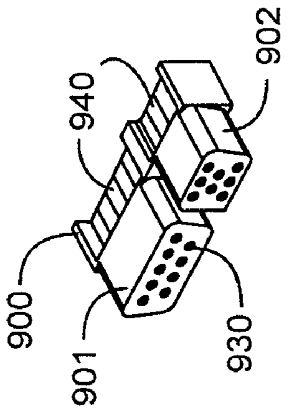


FIG. 9B

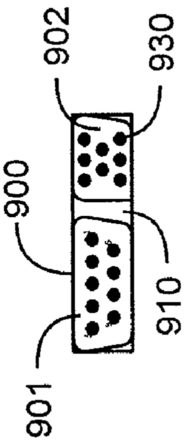


FIG. 9C

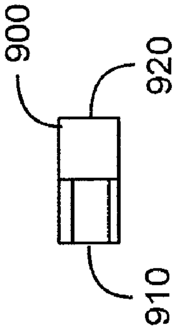


FIG. 9D

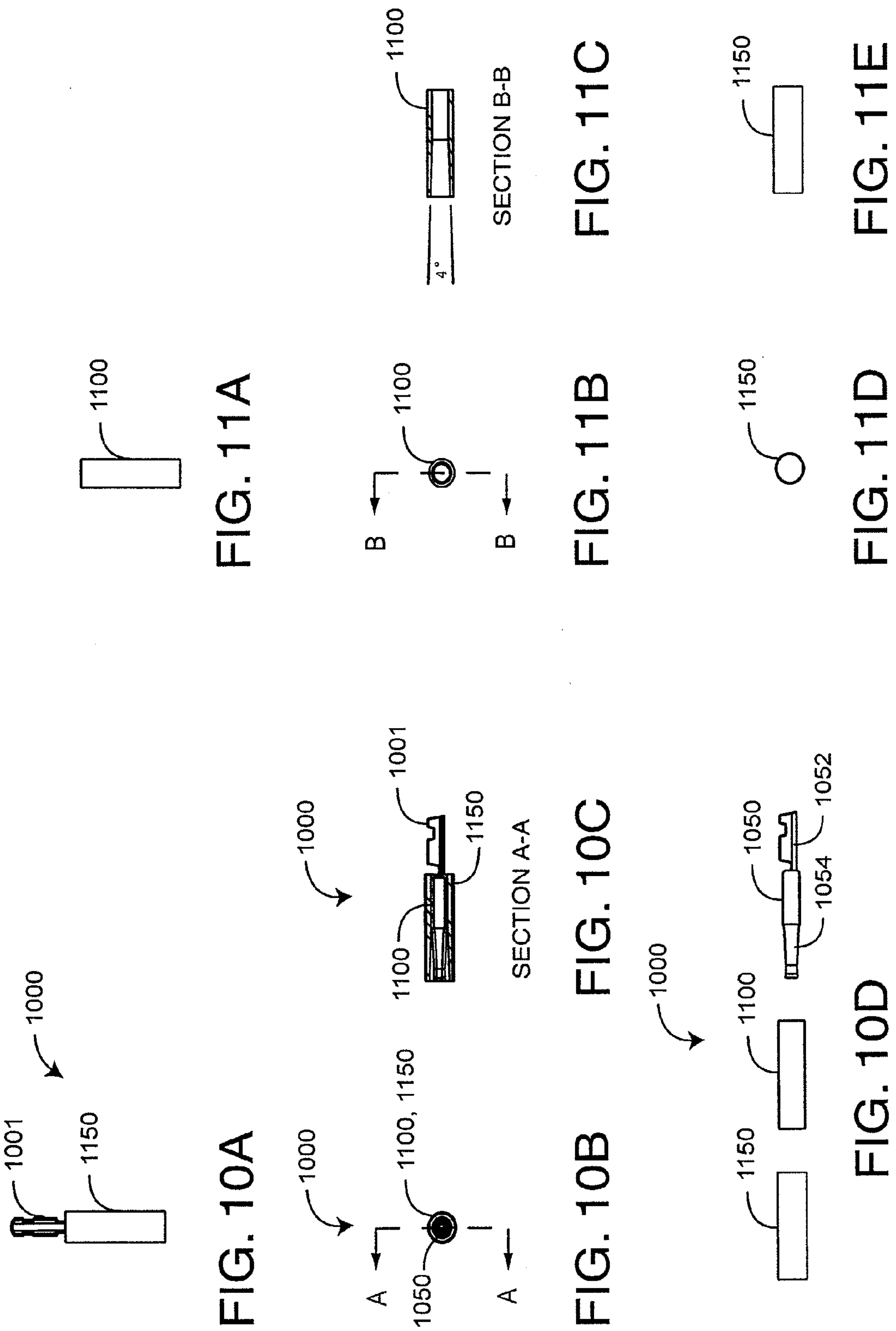


FIG. 10A

FIG. 10B

FIG. 10C

FIG. 10D

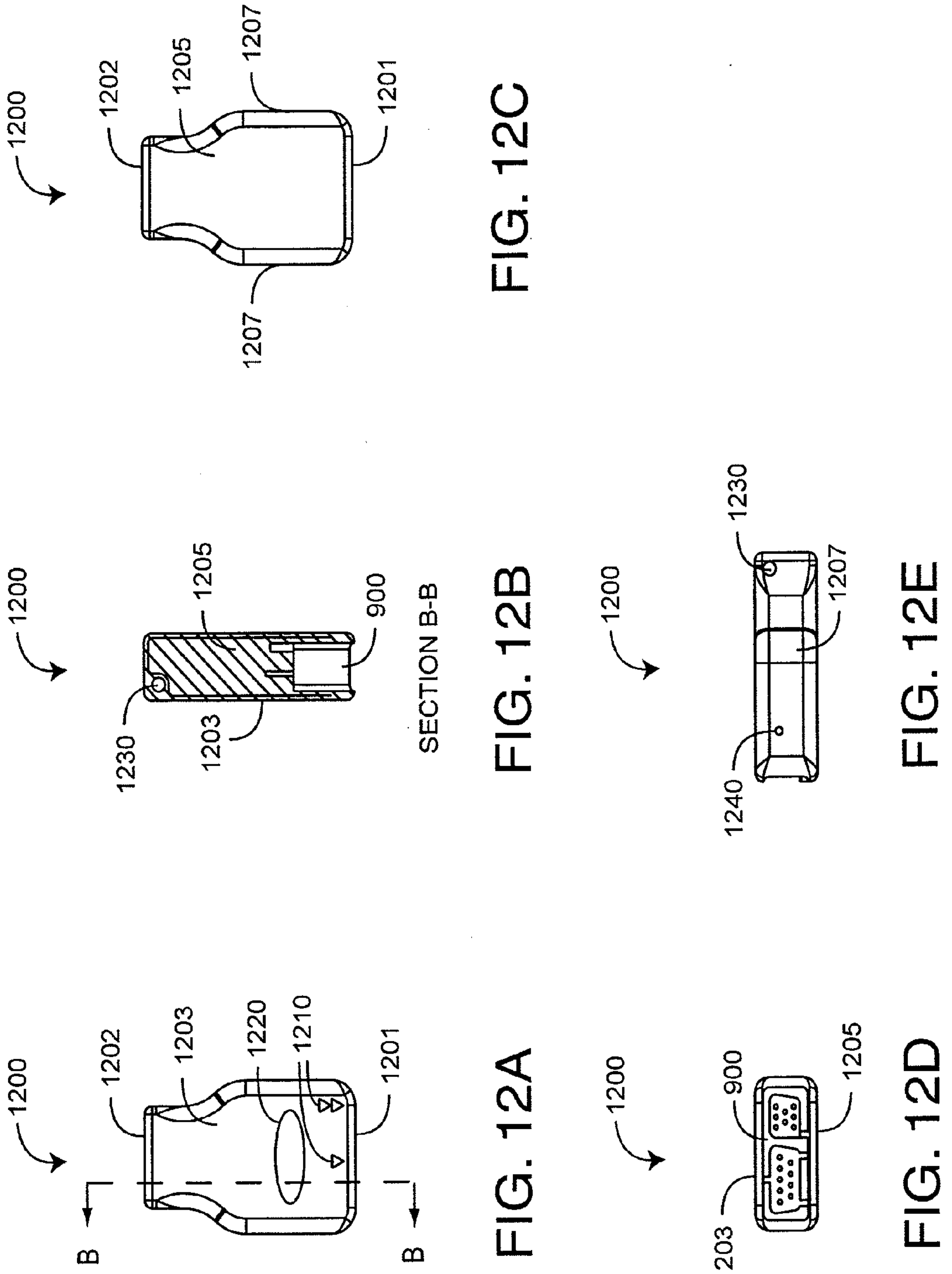
FIG. 11A

FIG. 11B

FIG. 11C

FIG. 11D

FIG. 11E


1200
1202
1205
1207
1201
1207
FIG. 12C
1200
1205
900
1230
1203
SECTION B-B
FIG. 12B
1200
1230
1207
1240
FIG. 12E
1200
1202
1203
1220
1210
1201
B
B
FIG. 12A
1200
900
1205
1203
FIG. 12D

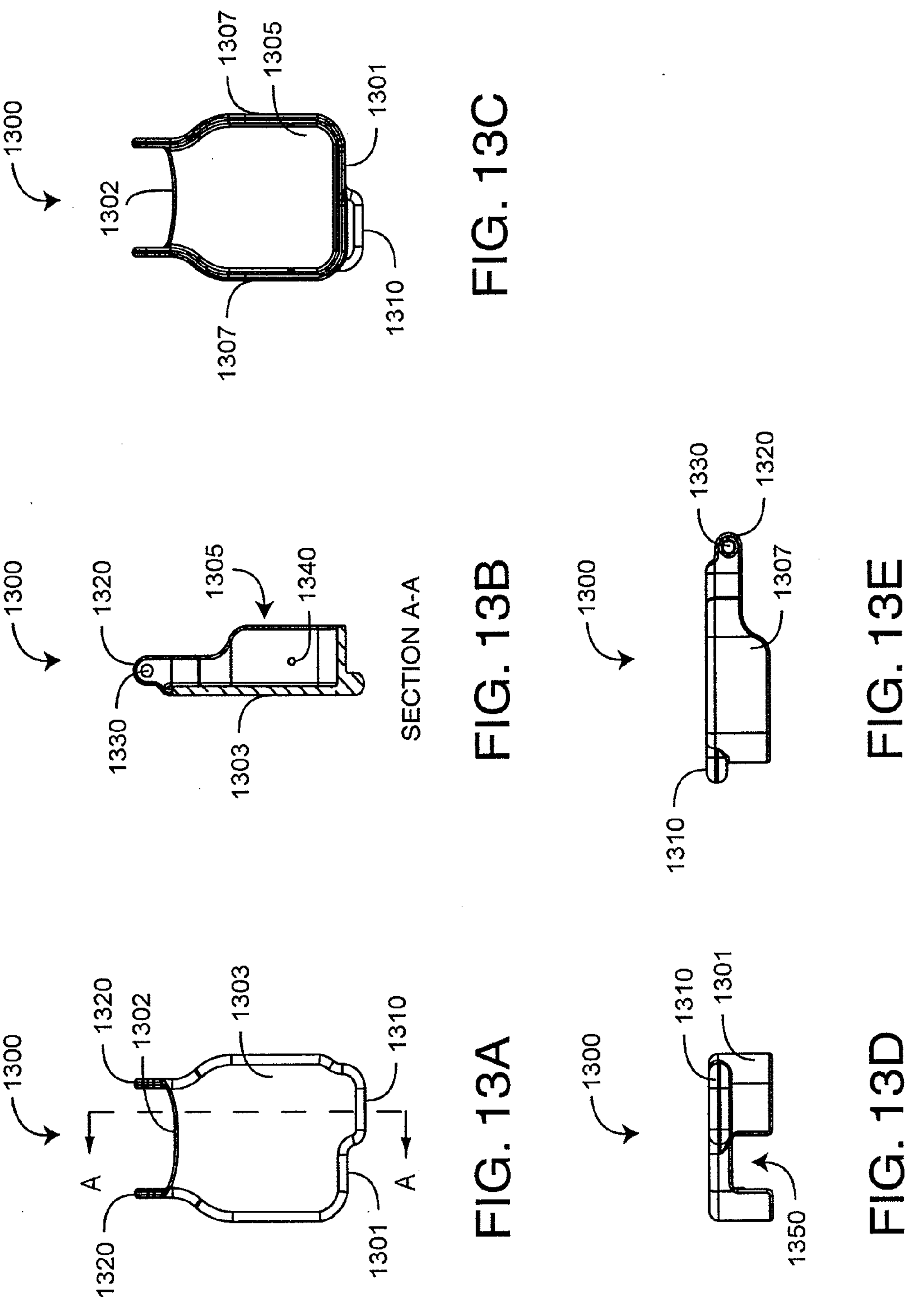


FIG. 13C

FIG. 13B

FIG. 13E

FIG. 13A

FIG. 13D

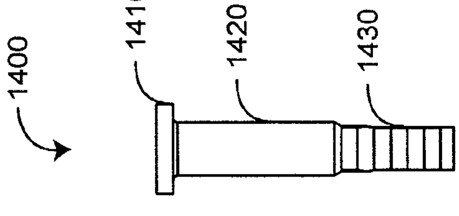


FIG. 14A

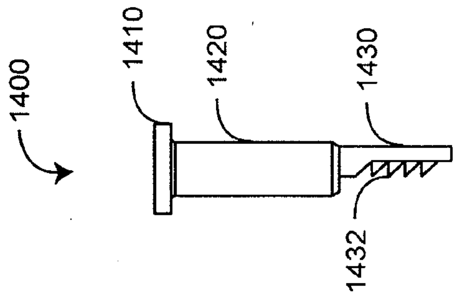


FIG. 14B

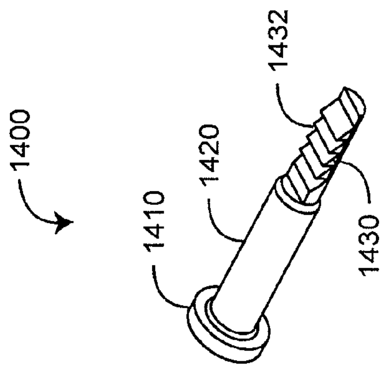


FIG. 14C

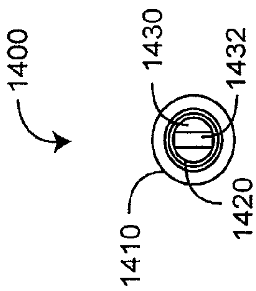


FIG. 14D

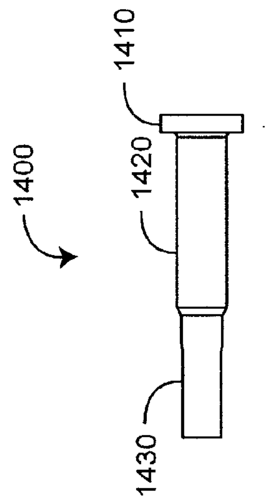


FIG. 14E

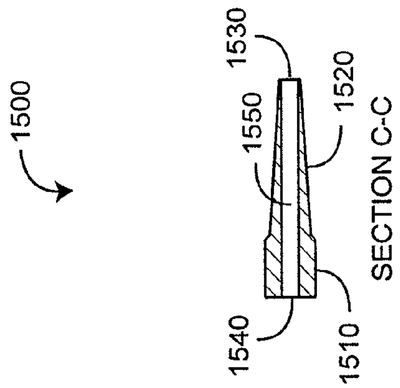


FIG. 15B

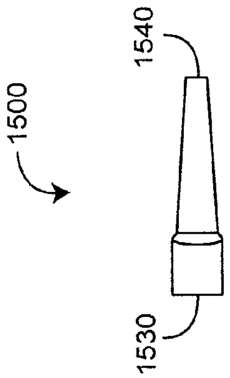


FIG. 15D

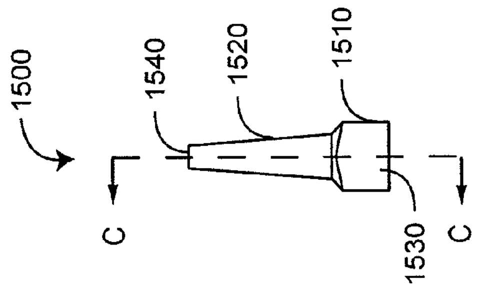


FIG. 15A

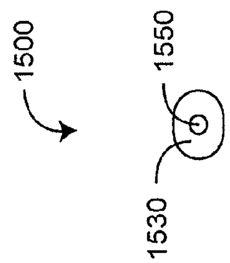


FIG. 15C

DUO CONNECTOR PATIENT CABLE

REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority benefit under 35 U.S.C. §119(e) from U.S. Provisional Application No. 60/846,260, filed Sep. 20, 2006, entitled "Duo Connector Patient Cable," which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Pulse oximetry provides a noninvasive procedure for measuring the oxygen status of circulating blood and has gained rapid acceptance in a wide variety of medical applications, including surgical wards, intensive care and neonatal units, general wards, and home care and physical training. A pulse oximetry system has a physiological sensor applied to a patient, a monitor, and a patient cable connecting the sensor and the monitor. The sensor has light emitters and a detector, which are attached to a tissue site, such as a finger. The patient cable transmits emitter drive signals from the monitor to the sensor. The emitters respond to the drive signals so as to transmit light into the tissue site. The detector is responsive to the emitted light after attenuation by pulsatile blood flowing in the tissue site, generating a detector signal to the monitor. The monitor processes the detector signal to provide a numerical readout of physiological parameters such as oxygen saturation (SpO_2) and pulse rate.

[0003] FIG. **1** illustrates portions of a pulse oximetry system **100** having a monitor **110**, a sensor **120** and a patient cable **130** interconnecting the monitor **110** and sensor **120**. The sensor **120** has LEDs **121**, **125** capable of emitting light having two wavelengths into a tissue site. The LEDs **121**, **125** are configured in a back-to-back arrangement so that a first contact **132** is connected to a first LED cathode **122** and a second LED anode **127**. A second contact **134** is connected to a first LED anode **123** and a second LED cathode **126**. The monitor **110** has a first driver **112** and a second driver **114**. The first contact **132** is in communications with a first driver **112** and the second contact **134** is in communications with a second driver **114**. The first LED **121** is activated when the first driver **112** is pulled to Vcc and the second driver **114** provides a current sink to ground. The second LED **125** is activated when the second driver **114** is pulled to Vcc and the first driver **112** provides a current sink to ground. Pulse oximeters capable of reading through motion induced noise are available from Masimo Corporation ("Masimo") of Irvine, Calif. Pulse oximeters capable of reading through motion induced noise are also disclosed in at least U.S. Pat. Nos. 6,770,028, 6,658,276, 6,157,850, 6,002,952 5,769,785, and 5,758,644, which are assigned to Masimo and are incorporated by reference herein.

SUMMARY OF THE INVENTION

[0004] A physiological measurement system can also be a multiple parameter monitor and a multiple wavelength sensor that provide enhanced measurement capabilities as compared with conventional pulse oximetry. The physiological measurement system allows the measurement of blood constituents and related parameters in addition to oxygen saturation and pulse rate, such as carboxyhemoglobin (HbCO) and methemoglobin (HbMet) to name a few.

[0005] FIG. **2** illustrates a multiple parameter system **200** having a multiple parameter monitor **210**, a multiple wavelength sensor **220** and a patient cable **230** interconnecting the monitor **210** and sensor **220**. The sensor **220** has an emitter array **262** having multiple LEDs **264** together capable of emitting light having multiple wavelengths into a tissue site. Anode drivers **232** and cathode drivers **234** are electrically connected to the LEDs **264** and activate LEDs by addressing at least one row **266** and at least one column **268** of an electrical grid. In an embodiment, the emitter array **262** has LEDs **264** connected within an electrical grid of n rows and m columns totaling n+m drive lines, where n and m integers greater than one. In an embodiment, the emitter array **262** comprises up to sixteen LEDs **264** configured in an electrical grid of four rows and four columns. Each of the four anode drive lines **272** provide a common anode connection to four LEDs **264**, and each of the four cathode drive lines **274** provide a common cathode connection to four LEDs **264**. Thus, the sixteen LEDs **264** are advantageously driven with only eight wires, including four anode drive lines **272** and four cathode **274** drive lines.

[0006] Also shown in FIG. **2**, anode drivers **212** and cathode drivers **214** located in the monitor **210** selectively activate the LEDs **264**. In particular, anode and cathode drivers function together as switches to Vcc and current sinks, respectively, to activate LEDs **264** and as switches to ground and Vcc, respectively, to deactivate LEDs. This push-pull drive configuration prevents parasitic current flow in deactivated LEDs. In a particular embodiment, only one anode drive line **232** is switched to Vcc at a time. One to four cathode drive lines **234**, however, can be simultaneously switched to a current sink so as to simultaneously activate multiple LEDs within a particular row. Multiple parameter monitors and multiple wavelength sensors capable of measuring blood constituents such as carboxyhemoglobin (HbCO) and methemoglobin (HbMet) are available from Masimo. Further, multiple parameter monitors and multiple wavelength sensors are disclosed in at least U.S. patent application Ser. Nos. 11/367,033 and 11/367,013, which are assigned to Masimo Laboratories, Irvine, Calif. and are incorporated by reference herein.

[0007] A duo connector patient cable is advantageously configured to accommodate either of two types of mating sensor connectors including a conventional connector for a pulse oximetry sensor and a multiple wavelength sensor connector. Further, a duo connector patient cable advantageously converts drive signals for array configured emitters into drive signals for back-to-back configured emitters. In additional, a duo connector patient cable advantageously reconfigures connector pinouts for a multiple wavelength sensor to optimize signal-to-noise ratio (SNR) performance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a block diagram of a conventional pulse oximetry system;

[0009] FIG. **2** is a block diagram of a multiple parameter system;

[0010] FIG. **3**A is a general block diagram of a duo connector patient cable utilized by a patient monitoring system;

[0011] FIG. 3B is a top view of a duo connector patient cable embodiment that accommodates a conventional pulse oximetry sensor connector and a multiple wavelength sensor connector;

[0012] FIGS. 4A-F are perspective, top, front, side, retainer hinged-open front and retainer hinged-open side views of a duo connector, respectively;

[0013] FIGS. 5A-C are a front view of a duo connector, a front view of a monitor connector and a schematic of a duo connector patient cable, respectively;

[0014] FIG. 6 is a block diagram of a multiple parameter patient monitoring system utilizing a duo connector patient cable;

[0015] FIG. 7A is a block diagram of a duo connector patient cable circuit;

[0016] FIG. 7B is a top layout view of a duo connector circuit board;

[0017] FIGS. 8A-C are perspective views of duo connector assemblies;

[0018] FIGS. 9A-D are top, perspective, front and side views, respectively, of a duo connector socket;

[0019] FIGS. 10A-D are top, front, side cross sectional and side exploded views, respectively, of a detector socket pin;

[0020] FIGS. 11A-C are top, front and side cross sections views, respectively, of a detector socket pin shroud;

[0021] FIGS. 11D-E are front and side views, respectively, of a detector socket pin shield;

[0022] FIGS. 12A-E are top, side cross sectional, bottom, front and side views, respectively, of a duo connector shell overmolded on a socket;

[0023] FIGS. 13A-E are top, side cross sectional, bottom, front and bottom views, respectively, of a duo connector retainer;

[0024] FIGS. 14A-E are top, side, perspective, front and side views, respectively, of a duo connector hinge pin; and

[0025] FIGS. 15A-D are top, side cross sectional, front and side views, respectively, of a duo connector strain relief.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0026] FIG. 3A generally illustrates a duo connector patient cable **300** as part of a patient monitoring system. Advantageously, the duo connector patient cable **300** allows both a SpO_2 sensor **10** and a multiple wavelength sensor **20** to communicate with a multiple parameter monitor **50**. In particular, a duo connector **310** accepts both a conventional pulse oximetry sensor and a multiple wavelength sensor, each having different connectors **12**, **22**. In an embodiment, the duo connector accepts a WTM LNCS® low noise enabled sensor and a RAINBOW™ multiple wavelength sensor. LNCS® brand sensors and RAINBOW™ brand monitors and sensors are available from Masimo Corporation. In addition, the duo connector patient cable **300** has an adapter circuit **600** that converts array drive signals configured for a multiple wavelength sensor **20** so as to drive back-to-back emitters of a SpO_2 sensor **10**. Further, the adapter circuit **600** reconfigures the duo connector patient cable **300** to a signal and ground pinout that has improved signal-to-noise ratio (SNR) and crosstalk performance when connected to a multiple wavelength sensor. An adapter circuit **600** is described in further detail with respect to FIGS. **6-7**, below.

[0027] FIG. 3B illustrates a duo connector patient cable **300** having a duo connector **400**, a monitor connector **310** and a cable **350** having wires that interconnect the duo connector **400** and monitor connector **310**. The duo connector **400** advantageously accommodates a conventional SpO_2 sensor connector **15** and a multiple wavelength sensor connector **1800**. In an embodiment, a SpO_2 sensor **10** is plugged into the patient cable **300** so that a SpO_2 sensor alignment arrow **16** matches a first patient cable alignment arrow **401**. Also a multiple wavelength sensor **20** is plugged into the patient cable **300** so that a multiple wavelength sensor alignment arrow **1803** matches a second patient cable alignment arrow **402**. The cable alignment arrows **401**, **402** (shown hidden) are inscribed on a connector shell **1200** (FIG. **12**A) covered by a retainer **1300** (FIGS. **13**A-E) that is opened during sensor attachment. In an embodiment, the SpO_2 sensor connector **15** is a 9-pin mini-D connector, which is well-known in the art. The monitor connector **310** is a 20-pin DB connector, which is also well-known in the art and further described with respect to FIG. **5**B, below. Physical aspects of the duo connector **400** are described generally with respect to FIGS. **4**A-F and in greater detail with respect to FIGS. **8-15**. The duo connector signals, grounds and pinouts are described with respect to FIGS. **5-7**. The adapter circuit **600** (FIG. **6**) for configuring the duo connector **400** to accommodate either a two-wavelength SpO_2 sensor or a multiple wavelength sensor is described with respect to FIGS. **6-7**.

[0028] FIGS. **4**A-F illustrate a duo connector **400** having a front **401** and a back **402**. The front **401** has a socket **900** that accommodates either of two mating sensor plugs **15**, **1800** (FIG. 3B). The back **402** terminates a cable **350** (FIG. 3B). The duo connector socket **900** has a first socket section **901** configured for a conventional SpO_2 sensor plug **15** (FIG. 3B) and a second socket section **902**, which along with the first socket section **901** is configured for a multiple wavelength sensor plug **1800** (FIG. 3B). In particular, the first socket section **901** has pinouts for back-to-back LED drive signals from a monitor to a sensor and detector signals and sensor information from the sensor to the monitor. The second socket section **902** has pinouts for LED array drive signals from a monitor to a sensor. The pinouts for the socket sections **901**, **902** are described in further detail with respect to FIGS. **5**A-C, below. The duo connector **400** also has a retainer **1300** movable between a closed position (FIGS. **4**A-D) and an open position (FIGS. **4**E-F). In the open position, the retainer **1300** allows either sensor plug **15**, **1800** (FIG. 3B) to be inserted into or removed from the socket **900**. In the closed position, the retainer **1300** prevents either sensor plug **15**, **1800** (FIG. 3B) from inadvertently disconnecting from the socket **900**.

[0029] FIGS. **5**A-C illustrate a duo connector patient cable **300**. In particular, the socket **900** (FIG. **5**A) and the corresponding sensor pinouts **520** (FIG. **5**C) relate to the duo connector **400** (FIG. **5**A). Also, the monitor socket **312** (FIG. **5**B) and the corresponding monitor pinouts **510** relate to the monitor connector **310** (FIG. **5**B). Also illustrated in is a circuit board **700** (FIG. **5**C) that resides in the duo connector **400**, as described with respect to FIGS. **7-8**, below, and that switches the pinouts under monitor control according to the sensor **10**, **20** (FIGS. **3**A-B) plugged into the duo connector **400**.

[**0030**] As shown in FIGS. **5**A-C, the duo connector pinouts **520** are divided into pins **1-9**, associated with a first socket section **901** and pins **10-17** associated with a second socket section **902**. When a SpO_2 sensor **10** (FIGS. **3**A-B) is inserted into the first socket section **901**, the monitor detects the SpO_2 sensor from the "1-wire comm" line connecting the sensor side (pin **4**) **520** and the monitor side (pin **15**) **510**. The monitor then sets the "control" line on pin **8510** so that the circuit board **700** converts the first two LED cathode drive signals (pins **3**, **13**) **510** and LED anode drive signals (pins **1**, **11**) **510** to a red cathode drive signal (pin **2**) **520** and an IR cathode drive signals (pin **3**) **520**.

[**0031**] Also as shown in FIGS. **5**A-C, when a multiple wavelength sensor **20** (FIGS. **3**A-B) is inserted into the socket sections **901**, **902**, the monitor detects the sensor from the "1-wire comm" line connecting the sensor side (pin **4**) **520** and the monitor side (pin **15**) **510**. The monitor then sets the "control" line (pin **8**) **510** so that the circuit board **700** grounds the now unused drive signal lines (pins **2**, **3**) **520**. That is, for the higher performance multiple wavelength sensor **20** (FIGS. **3**A-B), the detector signals (pins **5**, **9**) **520** on the first socket section **901** are advantageously isolated from the drive signals (pins **10-17**) **520** on the second socket section **902**. This reduces the possibility of cross-talk from drive lines to detector lines. Further, the detector signals (pins **5**, **9**) **522** are separately shielded **1150**, and the shields **1150** are grounded to a cable inner shield (pin **6**) **524**, providing further noise immunity for the detector signal.

[**0032**] FIG. **6** illustrates portions of a multiple parameter system embodiment having a multiple parameter monitor **50** and a duo connector patient cable **300** interconnecting either a SpO_2 sensor **10** or a multiple wavelength sensor **20**. The duo connector patient cable **300** advantageously incorporates an adapter circuit **600** allowing the multiple parameter monitor **50** to drive either back-to-back (red and IR wavelength) LEDs **12** of a SpO_2 sensor **10** or a LED array **22** of a multiple wavelength sensor **20**. In particular, the patient cable **300** has array lines **610** configured to communicate array drive signals **52** to a LED array **22**, as described with respect to FIG. **2**, above. The patient cable **300** also has an adapter circuit **600** that configures an array line subset **612** so as to communicate array drive signals **52** to back-to-back LEDs **12**.

[**0033**] As shown in FIG. **6**, the adapter circuit **600** incorporates switches **660** that selectively route the array line subset **612** so that the array drive signals **52** activate the back-to-back LEDs **12** when the monitor **50** senses a SpO_2 sensor **10** is connected to the patient cable **300**. When the monitor **50** senses a multiple wavelength sensor **20** is connected to the patient cable **300**, the switches **660** advantageously ground certain of the sensor connector pins (not shown) so as to minimize cross-talk between drive signals **52** and detector signals (not shown), as described in further detail below. In an embodiment, the monitor **50** utilizes eight array lines **610** to drive a four-by-four emitter array **22** of up to sixteen LEDs. Four of the array lines **612** are routed through the switches **660** to back-to-back lines **614**, as described in further detail with respect to FIGS. **7**A-B, below.

[**0034**] Also shown in FIG. **6**, in an embodiment, a network controller **56** monitors a network **630** so as to read an information element from either sensor **10**, **20** to identify either a SpO_2 sensor **10** or a multiple wavelength sensor **20**. The network controller **56** can also read the EEPROM **670** over the network **630** so that the monitor **50** can identify a duo sensor patient cable **300** is attached. The monitor **50** also has a switch control **54** that provides a control **620** in response to information from the network **630**. That is, the control **620** configures the switches **660** according to the sensor **10**, **20** that is attached to the duo connector patient cable **300**.

[**0035**] FIGS. **7**A-B illustrate an adapter circuit **600** and a corresponding circuit board **700**. As shown in FIG. **7**A, an adapter circuit **600** embodiment has array lines **612**, a control **620** and a network **630**, as described with respect to FIG. **6**, above. The adapter circuit **600** also has switch **660** and an EEPROM **670**, as described with respect to FIG. **6**, above. The array lines **612**, control **620** and network **630** connect to a monitor **50** (FIG. **6**) via monitor-side pads **780**. The array lines **612** and network **630** also connect to a sensor **10**, **20** (FIG. **6**) via sensor-side pads **770**. Switches **660** include a first switch IC **662** and a second switch IC **664** each having dual single-pole, double-throw switches responsive to the control **620**. In an embodiment, the switch ICs **662**, **664** are each MAX **4684** available from Maxim Integrated Products, Inc., Sunnyvale, Calif. ("Maxim"). In an embodiment, the network **630** is a single wire, and the EEPROM is a DS2431X, also available from Maxim. As shown in FIG. **7**B the circuit board **700** has a plurality of solder pads **770**, **780** adapted for wire connections. Sensor-side pads **770** accommodate jumper wires **810** (FIG. **8**A) to duo connector pins. Monitor-side pads **780** accommodate wires from the cable **350** (FIG. **3**).

[**0036**] Also shown in FIG. **7**A, when the control **620** is asserted, the four switches route a combination of cathode**1** and anode**1** signal and a combination of cathode**2** and anode**2** signal to the IR and red cathodes **614**, respectively. In this manner, the monitor can activate the back-to-back LEDs as if connected in an array. That is, an IR LED is activated by pulling up cathode**1** and current sinking anode**2** and a red LED is activated by pulling up cathode **2** and current sinking anode**1**. When the control **620** is not asserted, the first switch IC **662** grounds the IR and red cathode lines **614**. In this manner, when a SpO2 sensor is not connected, the drive lines proximate to the detector lines are grounded, so as to reduce the possibility of signal crosstalk inducing noise on the detector signal, as described above.

[**0037**] FIGS. **8**A-C illustrate duo connector assemblies including a wiring assembly **801**, a shielded wiring assembly **803** and a shell assembly **805**. As shown in FIG. **8**A, the wiring assembly **801** includes a circuit board **700**, a socket **900**, a cable **350**, jumper wires **810**, cable wires **820** and socket pins **1050**. A first portion of the cable wires **820**, including detector wires and a first portion of array drive wires, extend to the socket pins **1050**. A second portion of the cable wires **820**, including a network wire, a control wire, and a second portion of the array drive wires, extend to monitor-side pads **780** (FIG. **7**B) of the circuit board **700**.

The jumper wires **810** extend between the sensor-side pads **770** (FIG. 7B) of the circuit board **700** and the socket pins **1050** and include the red and IR cathode drive wires and the network wire. The socket **900** is described in detail with respect to FIGS. **9**A-D, below. The socket pins **1050** are described with respect to FIGS. **10-11**, below.

[0038] As shown in FIG. **8**B, the shielded wiring assembly **803** has a socket overmold **840** sealing the wiring assembly **801** so that no wires are exposed. The overmold is covered with a copper shield, which is grounded to the cable outer shield **526** (FIG. **5**C). In an embodiment, the socket overmold **820** is a PVC material.

[0039] As shown in FIG. **8**C, the shielded wiring assembly **803** is housed in the shell assembly **805**. The shell assembly **805** has a shell **1200**, a retainer **1300**, hinge pins **1400** and a bend relief **1500**. The shell **1200** encloses the shielded wiring assembly **803**. The retainer **1300** is hinged to the shell **1200** so as to removably retain either of the sensor connectors **15**,**1800** (FIG. **3**). The hinge pins **1400** secure the retainer **1300** to the shell **1200**. The bend relief **1500** protects the cable and cable wires proximate the shell **1200**. In an embodiment, the shell **1200** and the bend relief **1500** are overmolded to the shielded wiring assembly **803**. In a particular embodiment, the shell and bend relief overmolds are cast at the same time so that the bend relief **1500** is fused to the shell **1200**. The shell **1200** is described in further detail with respect to FIGS. **12**A-E, below. The retainer **1300** is described in further detail with respect to FIGS. **13**A-E, below. The hinge pins **1400** are described in further detail with respect to FIGS. **14**A-E. The bend relief **1500** is described in further detail with respect to FIGS. **15**A-D, below.

[0040] FIGS. **9**A-D illustrate a socket **900** having a front **910**, a back **920**, socket sections **901**, **902** proximate the front **910**, socket apertures **930** arranged in rows and extending through the socket sections **901**, **902** and pin holders **940** proximate the back **920** also arranged in rows corresponding to the socket apertures **930**. Each socket aperture **930** accepts a socket pin **1050** (FIG. **10**D), which mates with corresponding plug pins extending from a sensor plug **15**, **1800** (FIG. **3**B). Wiring of the socket **900** and socket pins **1050** (FIG. **10**D) are described above with respect to the wiring assembly **801** (FIG. **8**B). Socket pins including shielded detector sockets **1000** (FIGS. **10**A) are described in detail with respect to FIGS. **10-11**, below.

[0041] FIGS. **10**A-D illustrate a socket pin **1050** and a shielded detector socket **1000** utilizing the socket pin **1050**. The socket pin **1050** has a crimp **1052** for attaching wires and a body **1054** for receiving a mating connector pin. In an embodiment, the socket pin **1050** is a phosphor bronze with gold over nickel plating. A detector socket **1000** has a socket pin **1050**, an insulating shroud **1100** and a shield **1150**. The two detector lines **522** (FIG. **5**C) are terminated at two corresponding detector sockets **1000**, with the shield **1150** extending from the socket apertures **930** (FIGS. **9**B-C) proximate the pin holders **940** (FIG. **9**B) and connected to the cable inner shield **524** (FIG. **5**C).

[0042] FIGS. **11**A-C illustrate the detector socket shroud **1100** and shield **1150**. The shroud **1100** accepts a socket pin body **1054** (FIG. **10**D) and fits within the shield **1150**. In an embodiment, the shroud **1100** is polypropylene or DuPont Delrin®, and the shield is copper.

[0043] FIGS. **12**A-E illustrate a duo connector shell **1200** that houses a shielded wiring assembly **803** (FIG. **8**B) including a socket **900**. The shell **1200** is a generally rectangular enclosure having a front **1201**, a back **1202**, a top **1203** and a bottom **1205**. The shell **1200** is tapered proximate the back **1202** which is narrower than the front **1201**. On the top **1203**, the shell **1200** has arrow indicators **1210** proximate the front **1201** and an artwork recess **1220**. On both sides **1207**, the shell **1200** has hinge apertures **1230** and depressions **1240**. The front **1201** accommodates the socket sections **900** which accepts corresponding sensor connectors **15**, **1800** (FIG. **3**B). The back **1202** accommodates a patient cable **350** (FIG. **3**B) which is supported to proximate the shell **1200** by a bend relief **1500** (FIGS. **15**A-D). The arrow indicators **1210** match with corresponding sensor connector indicators **16**, **1803** (FIG. **3**B) providing a sensor connector alignment guide, as described with respect to FIG. **3**B, above. The hinge apertures **1230** accommodate the hinge pins **1400** (FIGS. **14**A-E) that attach the retainer **1300** (FIGS. **13**A-E) to the shell **1200**, as described with respect to FIGS. **4**A-F, above. The depressions **1240** accept corresponding retainer protrusions **1340** (FIG. **13**B) so as to releasably hold the retainer **1300** in a closed position shown in FIGS. **4**A-D. In an embodiment, the shell **1200** is overmolded on the shielded wiring assembly **803** (FIG. **8**B), including the socket **900**. In an embodiment, the shell **1200** is medical grade PVC of 90-100 Shore A durometer.

[0044] FIGS. **13**A-E illustrate a duo connector retainer **1300** configured to hinge to the shell **1200** (FIGS. **12**A-E) so as to removably retain sensor connectors **15**, **1800** (FIG. **3**B). The retainer **1300** is a generally rectangular cover having a front **1301**, a back **1302**, a top **1303** and a bottom **1305** and is configured to fit at least partially over the shell front **1201**, top **1203** and sides **1207** (FIGS. **12**A-E). Proximate the front and top **1301**,**1303**, the retainer **1300** has a protruding tab **1310** that accommodates a person's finger or thumb to easily open or close the retainer. Protruding from the retainer back **1302** and proximate the retainer sides **1307** are hinges **1320**, each having a hinge aperture **1330** configured to match up with corresponding shell hinge apertures **1230** (FIG. **12**E) so as to accommodate hinge pins **1400** (FIGS. **14**A-E). Extending inwardly from the retainer sides **1307** are protrusions **1340** (FIG. **13**B) configured to click into corresponding shell depressions **1240** (FIG. **12**E) so as to releasably hold the retainer **1300** in a closed position (FIGS. **4**A-D). The front **1301** has a cable aperture **1350** offset from the tab **1310** and configured to accommodate sensor cables immediately behind the sensor connectors **15**, **1800** (FIG. **3**B) to prevent inadvertent disconnection of sensors **10**, **20** (FIGS. **3**A-B) from the duo connector **400** (FIG. **3**B). In an embodiment, the retainer **1300** is a medical grade clear plastic.

[0045] FIGS. **14**A-E illustrate a duo connector hinge pin **1400** that rotatably attaches the retainer **1300** (FIGS. **13**A-E) to the shell **1200** (FIGS. **12**A-E). In particular, a pair of pins **1400** insert through retainer apertures **1220** (FIGS. **12**A-E) and shell apertures **1320** (FIGS. **13**A-E) from opposite directions and are fixedly latched together. The pin **1400** has a generally round head **1410**, a cylindrical shaft **1420** extending generally normal to the head **1410**, and a partially cylindrical latching portion **1430** extending from the end of the shaft **1420** distal the head **1410**. A plurality of teeth **1432** are disposed on the latching portion **1430**. The teeth **1432** are configured to slide past corresponding teeth on an opposite pin **1400** in one direction only, so as to latch together opposite facing pins. So disposed, the pin heads **1410** hold the shell **1200** (FIGS. **12**A-E) relative to the retainer **1300** (FIGS. **13**A-E) as the retainer rotates about the pin shafts **1420**.

[0046] FIGS. **15**A-D illustrate a bend relief **1500** that protects the cable from bending forces and the cable wires and corresponding solder joints from pulling forces. The bend relief **1500** is a generally tapered cylinder having a head **1510**, a tail **1520**, a front **1530**, a back **1540** and an axial cavity **1550** extending the length of the bend relief. In an embodiment, the bend relief **1500** is overmolded on the patient cable **350** (FIG. **3**B) so that the cable **350** is retained within the axial cavity **1550** so formed. The head **1510** is disposed proximate the shell back **1202** (FIGS. **12**A-E), with the tail **1520** extending distal the shell **1200** (FIGS. **12**A-E). In an embodiment, the bend relief **1500** is medical grade PVC having a 40-50 Shore A durometer. In an embodiment, the bend relief **1500** and shell **1200** are overmolded at the same time so that the bend relief front **1530** fuses to the shell back **1202** (FIGS. **12**A-E).

[0047] A duo connector patient cable has been disclosed in detail in connection with various embodiments. These embodiments are disclosed by way of examples only and are not to limit the scope of the claims that follow. One of ordinary skill in art will appreciate many variations and modifications.

What is claimed is:

1. In a patient monitoring system having a sensor configured to transmit at least two wavelengths of optical radiation into a tissue site and detect the radiation after attenuation by pulsatile blood flowing within the tissue site, a patient monitor configured to process a signal responsive to the detected radiation and generate at least one parameter indicative of a patient physical condition, a patient cable for interconnecting the sensor and patient monitor comprising:

a monitor connector configured to mate with a corresponding connector in a patient monitor;

a sensor connector configured to mate with either of two types of sensor connectors; and

a cable interconnecting the monitor connector and the sensor connector so as to transmit drive signals originating from the monitor to the sensor and to transmit sensor signals originating from the sensor to the monitor.

2. The patient cable according to claim 1 further comprising:

a first socket section configured to mate with a two-wavelength pulse oximeter sensor; and

a second socket section configured, along with the first socket section, to mate with a multiple wavelength sensor capable of transmitting more than two wavelengths of optical radiation into a tissue site.

3. The patient cable according to claim 2 further comprising a circuit for converting multiple wavelength sensor drive signals into two-wavelength sensor drive signals.

4. The patient cable according to claim 3 wherein the circuit comprises:

a circuit board housed in the sensor connector; and

a plurality of switches mounted to the circuit board,

wherein the switches route portions of array drive signals generated by the monitor to back-to-back drive signal pins in communications with the two-wavelength sensor.

5. The patient cable according to claim 4:

wherein the back-to-back signal drive pins are housed in the first socket section, and

wherein the array drive signals for the multiple wavelength sensor are communicated to the second section;

6. The patient cable according to claim 5 further comprising:

detector signal pins housed in the first socket section in communications with either the two-wavelength sensor or the multiple wavelength sensor when attached,

wherein drive signal pins housed in the first section are grounded when the multiple wavelength sensor is attached so as to improve noise isolation of the detector signal.

7. A patient cable method comprising the steps of:

providing a duo sensor connector having a first socket section and a second socket section;

removably attaching a first sensor having a conventional connector to the first socket section for making pulse oximetry measurements; and

removably attaching a second sensor having a mating duo connector to the first and second socket sections for making blood parameter measurements in additional to pulse oximetry measurements.

8. The patient cable method according to claim 7 comprising the further steps of:

communicating first drive signals to the first socket section; and

communicating second drive signals to the second socket section,

wherein a portion of the second drive signals are routed to the first socket section as the first drive signals when the first sensor is attached to the duo sensor connector.

9. The patient cable method according to claim 8 comprising the further step of converting second drive signals from a multiple parameter patient monitor configured for an LED array to first drive signals configured for back-to-back LEDs when the first sensor is attached to the duo sensor connector.

10. The patient cable method according to claim 9 comprising the further step of switching signals between pins in the first socket section and the second socket section within the duo sensor connector.

11. The patient cable method according to claim 10 comprising the further step of grounding drive signal pins in the first socket section when the second sensor is attached to the duo sensor connector so as to provide noise isolation of detector signal pins in the first socket section.

12. A patient cable for connecting a patient monitor to an optical sensor comprising:

a duo connector means for establishing communications between a monitor and one of a two-wavelength sensor having a conventional connector and a multiple wavelength sensor connector; and

an information means for identifying which of the sensors is attached to the duo connector means.

13. The patient cable according to claim 12 further comprising:

a switching means for converting array drive signals from the monitor to back-to-back drive signals for the two-wavelength sensor; and

a housing means for mounting the switching means with the duo connector means.

14. The patient cable according to claim 13 further comprising a configuration means for achieving improved noise isolation for a sensor signal when the multiple wavelength is attached to the duo connector means.

15. The patient cable according to claim 14 further comprising an overmold means for housing the duo connector means and the switching means and for creating a bend relief means.

* * * * *

专利名称(译)	Duo连接器患者电缆		
公开(公告)号	US20080071153A1	公开(公告)日	2008-03-20
申请号	US11/858818	申请日	2007-09-20
[标]申请(专利权)人(译)	梅西莫股份有限公司		
申请(专利权)人(译)	Masimo公司		
[标]发明人	AL ALI AMMAR ABDUL HAFIZ YASSIR FOREST KEVIN		
发明人	AL-ALI, AMMAR ABDUL-HAFIZ, YASSIR FOREST, KEVIN		
IPC分类号	A61B5/00		
CPC分类号	A61B5/14552 A61B5/1455 A61B2562/227 A61B2562/08		
优先权	60/846260 2006-09-20 US		
其他公开文献	US8315683		
外部链接	Espacenet USPTO		

摘要(译)

患者电缆具有双重传感器连接器，该双重传感器连接器具有第一插座部分和第二插座部分。第一插座部分被配置为可拆卸地连接双波长传感器。与第一插座部分结合的第二插座部分被配置为可拆卸地连接多波长传感器以代替双波长传感器。容纳在二重传感器连接器中的电路将适合于多波长传感器的发射器阵列驱动信号转换成适合于双波长传感器的背对背发射器驱动信号。