

example. Other information element 4300 embodiments connected to an electrical grid and read utilizing emitter array drivers incorporate other passive components, active components or memory components, alone or in combination, including transistor networks, PROMs, ROMs, EPROMs, EEPROMs, gate arrays and PLAs to name a few.

Sensor Cable

[0115] FIGS. 44A-B illustrate a sensor cable 4400 having an outer jacket 4410, an outer shield 4420, multiple outer wires 4430, an inner jacket 4440, an inner shield 4450, a conductive polymer 4460 and an inner twisted wire pair 4470. The outer wires 4430 are advantageously configured to compactly carry multiple drive signals to the emitter array 700 (FIG. 7). In one embodiment, there are twelve outer wires 4430 corresponding to four anode drive signals 4501 (FIG. 45), four cathode drive signals 4502 (FIG. 45), two thermistor pinouts 1450 (FIG. 15) and two spares. The inner twisted wire pair 4470 corresponds to the sensor signal 2500 (FIG. 25) and is extruded within the conductive polymer 4460 so as to reduce triboelectric noise. The shields 4420, 4450 and the twisted pair 4470 boost EMI and crosstalk immunity for the sensor signal 2500 (FIG. 25).

Controller

[0116] FIG. 45 illustrates a sensor controller 4500 located in the monitor 100 (FIG. 1) and configured to provide anode drive signals 4501 and cathode drive signals 4502 to the emitter array 700 (FIG. 7). The DSP (digital signal processor) 4040, which performs signal processing functions for the monitor, also provides commands 4042 to the sensor controller 4500. These commands determine drive signal 4501, 4502 levels and timing. The sensor controller 4500 has a command register 4510, an anode selector 4520, anode drivers 4530, current DACs (digital-to-analog converters) 4540, a current multiplexer 4550, cathode drivers 4560, a current meter 4570 and a current limiter 4580. The command register 4510 provides control signals responsive to the DSP commands 4042. In one embodiment, the command register 4510 is a shift register that loads serial command data 4042 from the DSP 4040 and synchronously sets output bits that select or enable various functions within the sensor controller 4500, as described below.

[0117] As shown in FIG. 45, the anode selector 4520 is responsive to anode select 4516 inputs from the command register 4510 that determine which emitter array row 810 (FIG. 8) is active. Accordingly, the anode selector 4520 sets one of the anode on 4522 outputs to the anode drivers 4530, which pulls up to Vcc one of the anode outputs 4501 to the emitter array 700 (FIG. 8).

[0118] Also shown in FIG. 45, the current DACs 4540 are responsive to command register data 4519 that determines the currents through each emitter array column 820 (FIG. 8). In one embodiment, there are four, 12-bit DACs associated with each emitter array column 820 (FIG. 8), sixteen DACs in total. That is, there are four DAC outputs 4542 associated with each emitter array column 820 (FIG. 8) corresponding to the currents associated with each row 810 (FIG. 8) along that column 820 (FIG. 8). In a particular embodiment, all sixteen DACs 4540 are organized as a single shift register, and the command register 4510 serially clocks DAC data 4519 into the DACs 4540. A current multiplexer 4550 is responsive to cathode on 4518 inputs

from the command register 4510 and anode on 4522 inputs from the anode selector 4520 so as to convert the appropriate DAC outputs 4542 to current set 4552 inputs to the cathode drivers 4560. The cathode drivers 4560 are responsive to the current set 4552 inputs to pull down to ground one to four of the cathode outputs 4502 to the emitter array 700 (FIG. 8).

[0119] The current meter 4570 outputs a current measure 4572 that indicates the total LED current driving the emitter array 700 (FIG. 8). The current limiter 4580 is responsive to the current measure 4572 and limits specified by the command register 4510 so as to prevent excessive power dissipation by the emitter array 700 (FIG. 8). The current limiter 4580 provides an enable 4582 output to the anode selector 4520. A Hi Limit 4512 input specifies the higher of two preset current limits. The current limiter 4580 latches the enable 4582 output in an off condition when the current limit is exceeded, disabling the anode selector 4520. A trip reset 4514 input resets the enable 4582 output to re-enable the anode selector 4520.

Sensor Assembly

[0120] As shown in FIG. 46, the sensor 400 has an emitter shell 3800, an emitter pad 3000, a flex circuit assembly 2200, a detector pad 3100 and a detector shell 3900. A sensor cable 4400 attaches to the flex circuit assembly 2200, which includes a flex circuit 2100, an emitter assembly 500 and a detector assembly 2400. The portion of the flex circuit assembly 2200 having the sensor cable 4400 attachment and emitter assembly 500 is housed by the emitter shell 3800 and emitter pad 3000. The portion of the flex circuit assembly 2200 having the detector assembly 2400 is housed by the detector shell 3900 and detector pad 3100. In particular, the detector assembly 2400 inserts into a shoe 3200, and the shoe 3200 inserts into the detector pad 3100. The emitter shell 3800 and detector shell 3900 are fastened by and rotate about hinge pins 410, which insert through coils of a spring 3600. The spring 3600 is held to the detector shell 3900 with a spring plate 3700. A finger stop 450 attaches to the detector shell. In one embodiment, a silicon adhesive 420 is used to attach the pads 3000, 3100 to the shells 3800, 3900, a silicon potting compound 430 is used to secure the emitter and detector assemblies 500, 2400 within the pads 3000, 3100, and a cyanoacrylic adhesive 440 secures the sensor cable 4400 to the emitter shell 3800.

[0121] A multiple wavelength sensor 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. A physiological sensor adapted to removably attach an emitter assembly and a detector assembly to a fingertip, the emitter assembly adapted to transmit optical radiation having a plurality of wavelengths into fingertip tissue, the detector assembly adapted to receive the optical radiation after attenuation by the fingertip tissue, the sensor comprising:

- a first shell;
- a second shell hinged to the first shell;