

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent of: Al-Ali  
U.S. Patent No.: 8,457,703 Attorney Docket No.: 50095-0002IP1  
Issue Date: June 4, 2013  
Appl. Serial No.: 11/939,519  
Filing Date: November 13, 2007  
Title: LOW POWER PULSE OXIMETER

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT  
NO. 8,457,703 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

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## EXHIBITS

APPLE-1001	U.S. Patent No. 8,457,703 to Al-Ali (“the ’703 Patent”)
APPLE-1002	Excerpts from the Prosecution History of the ’703 Patent
APPLE-1003	Declaration of Brian W. Anthony, Ph.D.
APPLE-1004	U.S. Patent No. 6,293,915 to Amano et al. (“Amano”)
APPLE-1005	U.S. Patent No. 6,393,311 to Edgar, Jr. et al. (“Edgar”)
APPLE-1006	U.S. Patent No. 6,527,729 to Turcott (“Turcott”)
APPLE-1007	U.S. Patent No. 5,632,272 to Diab et al. (“Diab”)
APPLE-1008	U.S. Patent No. 6,178,343 to Bindzus et al.
APPLE-1009	U.S. Patent No. 5,924,979 to Swedlow et al.
APPLE-1010	Tremper, <i>Pulse Oximetry</i> , Anesthesiology, The Journal of the American Society of Anesthesiologists, Inc., Vol. 70, No. 1 (January 1989)
APPLE-1011	Mendelson, <i>Skin Reflectance Pulse Oximetry: In Vivo Measurements from the Forearm and Calf</i> , Journal of Clinical Monitoring, Vol. 7, No. 1 (January 1991)
APPLE-1012	Excerpts from Bronzino, <i>The Biomedical Engineering Handbook</i> , CRC Press, Inc. (1995)
APPLE-1013	Konig, <i>Reflectance Pulse Oximetry – Principles and Obstetric Application in the Zurich System</i> , Journal of Clinical Monitoring, Vol. 14, No. 6 (August 1998)
APPLE-1014	U.S. Patent No. 5,490,505 to Diab et al.
APPLE-1015	U.S. Patent No. 5,027,410 to Williamson et al.

APPLE-1016	U.S. Patent Application Publication No. 2003/0004428 to Pless et al.
APPLE-1017	U.S. Patent Application Publication No. 2002/0032386 to Sackner et al.
APPLE-1018	U.S. Patent Application Publication No. 2003/0163287 to Vock et al.
APPLE-1019	U.S. Patent No. 6,163,721 to Thompson
APPLE-1020	U.S. Patent No. 5,058,203 to Inagami
APPLE-1021	U.S. Patent No. 6,711,691 to Howard et al.
APPLE-1022-1030	Reserved
APPLE-1031	Scheduling Order, Masimo v. Apple et al., Case 8:20-cv-00048, Paper 37 (April 17, 2020)
APPLE-1032	Stipulation by Apple
APPLE-1033	Telephonic Status Conference, Masimo v. Apple et al., Case 8:20-cv-00048, Paper 78 (July 13, 2020)
APPLE-1034	Joseph Guzman, “Fauci says second wave of coronavirus is ‘inevitable’”, TheHill.com (Apr. 29, 2020), available at: <a href="https://thehill.com/changing-america/resilience/natural-disasters/495211-fauci-says-second-wave-of-coronavirus-is">https://thehill.com/changing-america/resilience/natural-disasters/495211-fauci-says-second-wave-of-coronavirus-is</a>
APPLE-1035	“Tracking the coronavirus in Los Angeles County,” LATimes.com (Aug. 20, 2020), available at <a href="https://www.latimes.com/projects/california-coronavirus-cases-tracking-outbreak/los-angeles-county/">https://www.latimes.com/projects/california-coronavirus-cases-tracking-outbreak/los-angeles-county/</a>
APPLE-1036	Order Amending Scheduling Order, Masimo et al. v. True Wearables et al., Case 8:18-CV-02001 (July 7, 2020)

Apple Inc. (“Petitioner” or “Apple”) petitions for *Inter Partes* Review (“IPR”) of claims 1-7, 9-18, and 20-24 (“the Challenged Claims”) of U.S. Patent No. 8,457,703 (“the ’703 Patent”). The ’703 Patent describes a purported improvement to “a sleep-mode pulse oximeter... utilizing conventional sleep-mode power reduction” “where the circuitry is powered down,” and thus “the pulse oximeter is not functioning during sleep mode” which can result in “miss[ed] events, such as patient oxygen desaturation.” APPLE-1001, 1:63-2:2, 2:18-21. According to the ’703 Patent, the improved pulse oximeter uses processing characteristics to “regulate pulse oximeter power dissipation” by “reducing activation of an attached sensor” or “reducing an amount of processing.” APPLE-1001, 5:15-23, claims 1 and 9.

But this “improvement” was not new. To the contrary, the ’703 Patent was granted without full consideration to the wide body of applicable art. As Dr. Brian Anthony explains in his accompanying declaration with respect to the applied prior art, patient monitors such as pulse rate detectors and pulse oximeters commonly included these and other features before the ’703 Patent’s earliest effective filing date, and a patient monitor including each feature of the Challenged Claims would have been obvious to a POSITA. APPLE-1003, ¶¶37-127. For example, U.S. Patent No. 6,293,915 to Amano et al. (APPLE-1004) describes the exact limitations of the ’703 Patent’s proposed solution to the problem found in the prior

art “sleep-mode pulse oximeter.” APPLE-1001, 1:63-2:2, 2:18-21. Much like the ’703 Patent, Amano describes a pulse wave examination apparatus that “***reduce[s] power consumption*** in the apparatus” while allowing a subject to “detect his pulse condition ***continuously*** in his daily life” by suspending body movement processing operations (reducing an amount of processing) “when... no body movement is present.” APPLE-1004, 21:50-22:9, 35:54-64, 36:23-27, 38:26-27. Amano is not alone, as Turcott (APPLE-1006) describes “minimiz[ing] power consumption” by adjusting “the drive current” of the light emitter (reducing activation of an attached sensor). APPLE-1006, 11:51-59. Other references cited herein likewise disclose managing power consumption during continuous patient monitoring by adjusting behavior of a patient monitor, as discussed in detail below. Apple respectfully submits that an IPR should be instituted, and that the Challenged Claims should be canceled as unpatentable.

## **I. REQUIREMENTS FOR IPR**

### **A. Grounds for Standing**

Apple certifies that the ’703 Patent is available for IPR. The present Petition is being filed within one year of service of a complaint against Apple in *Masimo Corporation et al. v. Apple Inc.*, Case No. 8:20-cv-00048 (C.D. Cal.). Apple is not estopped from requesting this review challenging the Challenged Claims on the below-identified grounds.



**B. Challenge and Relief Requested**

An explanation of how these claims are unpatentable under the statutory grounds identified below is provided in the form of a detailed description that follow. Additional explanation and support for each ground of rejection is set forth in the Declaration of Brian W. Anthony, Ph.D. (APPLE-1003), referenced throughout this Petition.

Ground	Claims	§103 Basis
1A	9-10, 12-14, 20, 22-24	Diab (APPLE-1007) and Amano
1B	11, 21	Diab, Amano, and Edgar (APPLE-1005)
1C	1-7, 15-18	Diab, Amano, and Turcott (APPLE-1006)
2A	9-10, 12-14, 20, 22-24	Diab and the General Knowledge of a POSITA (GK-POSITA)
2B	11, 21	Diab, GK-POSITA, and Edgar
2C	1-7, 15-18	Diab, GK-POSITA, and Turcott
3A	9-10, 12-14, 20, 22-24	Amano (APPLE-1004)
3B	1-3, 15-17	Amano and Turcott (APPLE-1006)

Each reference pre-dates the provisional application (filed 7/2/2001) and qualifies as prior art:

Reference	Date	Section
Diab	5/27/1997 (issued)	102(b)
Amano	7/16/1999 (filed)	102(e)
Edgar	10/1/1999 (filed)	102(e)
Turcott	10/11/2000 (filed)	102(e)

None of these references were cited in any office action by the examiner during prosecution.

## **II. THE '703 PATENT**

### **A. Brief Description**

The '703 Patent relates to “a low power pulse oximeter.” APPLE-1001, 4:64-5:14, 5:14-15, FIG. 3. The pulse oximeter “utilizes multiple sampling mechanisms to alter power consumption.” APPLE-1001, 5:59-61; APPLE-1003, ¶¶26-29. The '703 patent describes that the sampling mechanisms “modify power consumption by, in effect, increasing or decreasing the number of input samples received and processed.” APPLE-1001, 6:9-11; APPLE-1003, ¶¶30-31. The patent states that “[s]ampling, including acquiring input signal samples and subsequent sample processing, can be reduced during high signal quality periods and increased during low signal quality periods or when critical measurements are necessary.” APPLE-1001, 6:11-15.

**B. Summary of the Prosecution History**

Original claims 1-16 were rejected based on U.S. Patent No. 5,924,979 to Swedlow et al. (“Swedlow”). APPLE-1002, 65-68. In the response to the first office action, the applicant argued that “Swedlow discloses a ‘sleep mode’ for a pulse oximeter” and the “sleep mode technologies, including Swedlow, do not teach or suggest continuous determination of measurement values” but “[r]ather, sleep mode disclosures, including Swedlow, simply turn off various portions/electronics for predetermined periods of time.” APPLE-1002, 91. As described in detail below, other prior art references—which were never before the examiner—teach or suggest the claimed features. APPLE-1003, ¶32.

**C. Level of Ordinary Skill in the Art**

A person of ordinary skill in the art relating to, and at the time of, the invention of the ’703 Patent (“POSITA”) would have had a Bachelor of Science degree in an academic discipline emphasizing the design of electrical, computer, or software technologies, in combination with training or at least one to two years of related work experience with capture and processing of data or information, including but not limited to physiological monitoring technologies or a Master of Science degree in a relevant academic discipline with less than a year of related work experience in the same discipline. APPLE-1003, ¶33.

#### **D. Claim Construction**

Petitioner submits that all claim terms should be construed according to the *Phillips* standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. § 42.100. Here, based on the evidence below and the prior art's description of the claimed elements being similar to that of the '703 patent specification, no formal claim constructions, except those discussed below, are necessary in this proceeding because "claim terms need only be construed to the extent necessary to resolve the controversy." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011).

##### **1. "reducing/reduce activation of an attached sensor" (claims 1 and 15)**

We construe this phrase as "reducing the duty cycle of an emitter driver output to the sensor" or "entering a data off state for a time period in which the emitter drivers are turned off." APPLE-1003, ¶36. This construction is consistent with the '703 Patent disclosure, as understood by a POSITA, which states that "[i]ntermittently reducing the drive current duty cycle can advantageously reduce power dissipation" and "[i]n conjunction with an intermittently reduced duty cycle or as an independent sampling mechanism, there may be a 'data off' time period longer than one drive current cycle where the emitter drivers... are turned off." APPLE-1001, 3:28-30, 6:66-7:1, 7:8-12; APPLE-1003, ¶36.

Moreover, regardless of whether the particular language offered by this proposed construction is adopted, the scope of the phrase “reducing/reduce activation of an attached sensor” should nonetheless be broad enough to encompass “reducing the duty cycle of an emitter driver output to the sensor” and “entering a data off state for a time period in which the emitter drivers are turned off.” *See* APPLE-1001, 3:28-30, 6:66-7:1, 7:8-12; APPLE-1003, ¶36.

### **III. UNPATENTABILITY GROUNDS**

#### **A. GROUND 1A: Claims 9-10, 12-14, 20, and 22-24 are obvious based on Diab and Amano**

##### **1. Overview of Diab<sup>1</sup>**

Diab describes “a physiological monitor for pulse oximetry” referred to as “pulse oximeter 299.” APPLE-1007, 34:10-12, FIG. 11. The oximeter includes “a digital signal processing system 334” that “provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display.” APPLE-1007, 35:34-47, 34:24-28, FIGS. 13-14. The signal processor 334 performs functions of a “pulse rate module 410” that includes

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<sup>1</sup> General descriptions provided for the references, including but not limited to Diab, and combinations thereof are hereby incorporated into each subsection addressing/applying those references, as are the discussions of combinations.

“a motion status module 584,” the output of which is provided to “a motion artifact suppression module 580.” APPLE-1007, 38:61-63, 47:30-38, 47:47-49, FIGS. 14, 20. An “average peak width value” is input to the motion status module 584, and “if the peaks are wide, this is taken as an indication of motion.” APPLE-1007, 47:50-52, FIG. 20. “If motion is not detected, spectral estimation on the signals is carried out directly without motion artifact suppression,” and “[i]n the case of motion, motion artifacts are suppressed using the motion artifact suppression module 580.” APPLE-1007, 47:52-56. The “output filter 594” of the pulse rate module 410 provides “the pulse of the patient, which is advantageously provided to the display.” APPLE-1007, 48:3-5, 50:27-29; APPLE-1003, ¶¶37-40.

## **2. Overview of Amano**

Amano describes a “pulse wave examination apparatus” that includes a “pulse wave detecting section 10.” APPLE-1004, 40:23-24. Amano teaches that, in the context of processing the detected pulse wave obtained from a LED and a phototransistor of the pulse wave detection section 10, “when the body movement component eliminating section 30 is made to operate for the elimination of the body movement component [from the detected pulse wave] even if there is no body movement,... power is consumed by the body movement eliminating operation.” APPLE-1004, 21:3-57. Amano provides a solution where “when no body movement is present, the operations of the waveform treating section 21 and

body movement component eliminating section 30 are suspended,” which “reduce[s] power consumption in the apparatus.” APPLE-1004, 21:65-22:6, 35:54-64. Thus, Amano teaches reducing power consumption by suspending unnecessary processing operations. *Id.*; APPLE-1003, ¶¶41-42.

### **3. The Combination of Diab and Amano**

In light of Amano’s teaching that “power is consumed by the body movement eliminating operation,” a POSITA would have found obvious that operating Diab’s “motion artifact suppression module 580” likewise consumes power. APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1007, 47:52-56, 48:34-49:38; APPLE-1003, ¶43. Additionally, in light of Amano’s teaching that suspending “the operations of... body movement component eliminating section” reduces power consumption, a POSITA would have found obvious that performing Diab’s “spectral estimation on the signals... directly *without* motion artifact suppression”<sup>2</sup> similarly reduces power consumption. *Id.* In light of Amano’s teaching of reducing power consumption by suspending unnecessary processing operations, a POSITA would have found obvious that Diab’s oximeter likewise reduces power consumption by performing “spectral estimation on the signals... directly *without* motion artifact suppression.” *Id.*

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<sup>2</sup> All emphasis added unless otherwise indicated.

#### **4. Reasons to Combine Diab and Amano**

A POSITA would have been motivated to and would have found it obvious and straightforward to supplement Diab's teachings with the teachings of Amano as described above. APPLE-1003, ¶44. Both Diab and Amano are in the same field of art and relate to devices that provide pulse waveforms. APPLE-1004, 21:3-8, 29:23-25, 31:2-8, 33:50-54, 34:3-14, 35:17-21, 36:23-27, 38:26-27, 40:23-27; APPLE-1007, 34:27-28, 35:44-47, 49:25-32. Both Amano and Diab disclose a need to eliminate motion-induced noise from a pulse waveform. APPLE-1004, 33:54-67; APPLE-1007, 2:23-26, 2:53-3:9, 34:1-9.

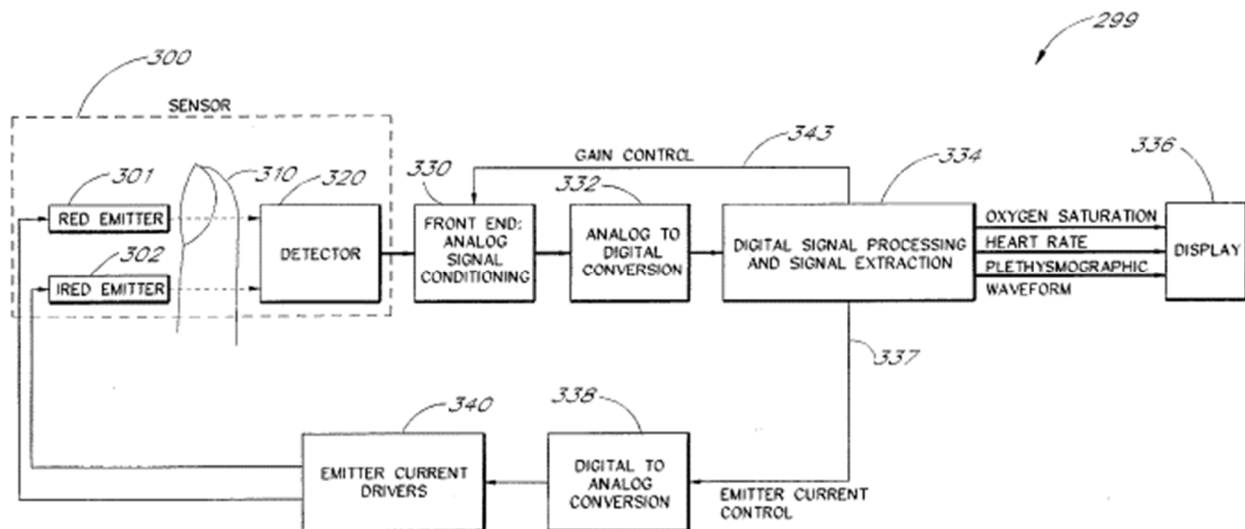
Amano is offered to demonstrate that reducing the amount of processing by suspending operations reduces power consumption. APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1007, 47:52-56, 48:34-49:38; APPLE-1003, ¶45. A POSITA faced with Diab's disclosure would look to similar systems, such as Amano, to obtain more information on the effect of Diab's reduction in processing. *Id.* Amano's teachings reveal to a POSITA that changes in power consumption were obvious from changes in the amount of processing that are contemplated by Diab. *Id.* A POSITA would have recognized that supplementing Diab's teachings with the teachings of Amano as described above would have led to predictable results without significantly altering or hindering the functions performed by Diab's oximeter. *Id.*



5. Claim 9

9[p]: “A method of managing power consumption during continuous patient monitoring by adjusting behavior of a patient monitor, the method comprising:”

In the combination, Diab teaches a method for operating “a physiological monitor for pulse oximetry” referred to as “pulse oximeter 299” that “compute[s] the arterial and venous blood oxygen saturations of a physiological system on a *continuous* or nearly continuous time basis.” APPLE-1007, 34:10-12, 63:38-41, FIG. 11; APPLE-1003, ¶46. The oximeter includes “a digital signal processing system 334” that “provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display.” APPLE-1007, 35:34-47, 34:24-28, FIGS. 13-14. A portion of the functional diagram of the oximeter 299 is shown below:



APPLE-1007, Detail of FIG. 11

Diab's signal processor 334 adjusts behavior of the oximeter during continuous patient monitoring by including "a motion status module 584," the output of which is provided to "a motion artifact suppression module 580." APPLE-1007, 47:30-38, 47:47-49, FIGS. 14, 20; APPLE-1003, ¶¶47-48. An "average peak width value" is input to the motion status module 584, and "if the peaks are wide, this is taken as an indication of motion." APPLE-1007, 47:50-52, FIG. 20. "If motion is not detected, spectral estimation on the signals is carried out directly without motion artifact suppression," and "[i]n the case of motion, motion artifacts are suppressed using the motion artifact suppression module 580." APPLE-1007, 47:52-56. Thus, Diab adjusts the behavior of the oximeter by (1) not performing motion artifact suppression when motion is not detected and (2) suppressing motion artifacts when motion is detected. APPLE-1007, 47:52-56; APPLE-1003, ¶¶47-48.

Also in the combination, Amano teaches that "when the body movement component eliminating section... is made to operate... power is consumed by the body movement eliminating operation" and "when no body movement is present, the operations of... body movement component eliminating section... are suspended," "thereby *reducing* calculation time and *power consumption*." APPLE-1004, 21:50-22:6, 35:54-64. A POSITA would have found obvious that operating Diab's "motion artifact suppression module 580" consumes power based

on Amano's teaching that "power is consumed by the body movement eliminating operation" to Diab's oximeter. APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1007, 48:34-49:38; APPLE-1003, ¶49.

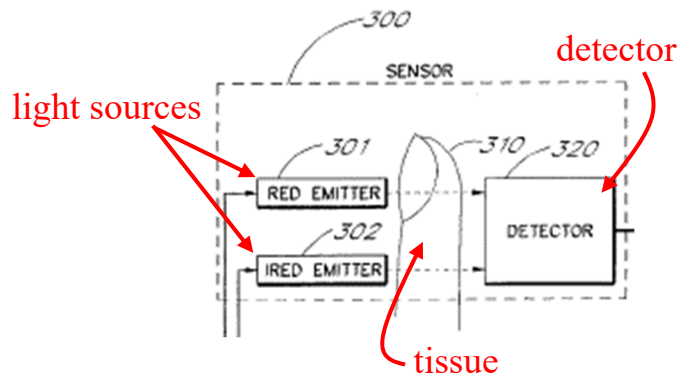
Additionally, a POSITA would have found obvious that performing "spectral estimation on the signals... directly *without* motion artifact suppression" reduces power consumption based on Amano's teaching that suspending "the operations of... body movement component eliminating section" reduces power consumption. *Id.*; APPLE-1003, ¶50. A POSITA would have been motivated and would have found it obvious and straightforward to combine Diab with Amano to manage power consumption by "reducing calculation time and power consumption," as suggested by Amano, "[i]f motion is not detected" by performing "spectral estimation on the signals... directly *without* motion artifact suppression," as taught by Diab. *Id.*

**9[a]: "driving one or more light sources configured to emit light into tissue of a monitored patient;"**

**9[b]: "receiving one or more signals from one or more detectors configured to detect said light after attenuation by said tissue;"**

In the combination, Diab's "pulse oximeter... non-invasively measures the arterial saturation of oxygen in the blood." APPLE-1007, 2:66-3:1. Diab's oximeter 299 includes "*red and infrared light emitters 301, 302* [that] each emits energy which is absorbed by the finger 310 and received by the *photodetector 320*"

after attenuation by the finger. APPLE-1007, 35:23-27, 4:51-57, 33:51-60, 34:12-19; APPLE-1003, ¶51. “The finger comprises skin, tissue, muscle, both arterial blood and venous blood, fat, etc., each of which absorbs light energy.” APPLE-1007, 33:60-64. A portion of the functional diagram of the oximeter 299 showing the sensor is below:



APPLE-1007, Detail of FIG. 11 (annotated)

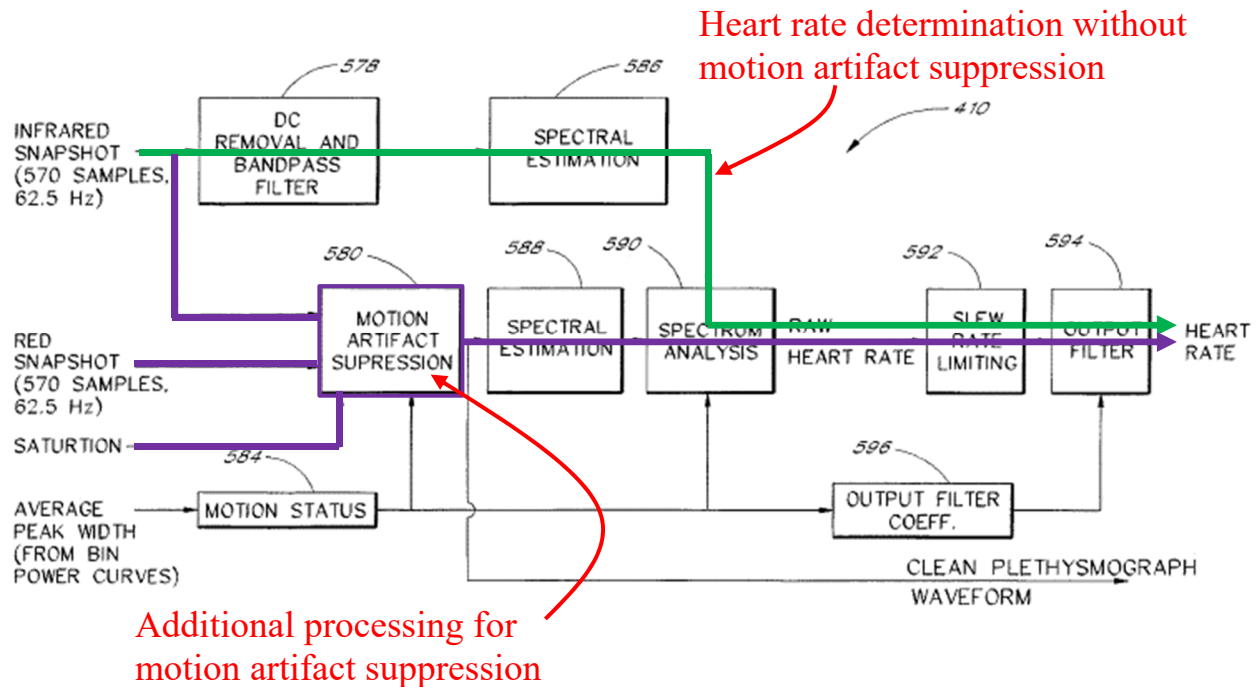
**9[c]: “continuously operating a patient monitor at a lower power consumption level to determine measurement values for one or more physiological parameters of a patient;”**

In the combination, Diab’s oximeter includes “a digital signal processing system 334” that includes a “digital signal processor 362” that carries out “the operations of the pulse oximeter 299” depicted in FIGS. 14-20. APPLE-1007, 38:31-38, 38:61-63. The signal processor “provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display.” APPLE-1007, 35:34-47, 34:24-28, FIGS. 13-14. The signal processor 334 of the oximeter 299 performs functions of a “pulse rate

module 410” that includes “a motion status module 584,” the output of which is provided to “a motion artifact suppression module 580.” APPLE-1007, 38:61-63, 47:30-38, 47:47-49, FIGS. 14, 20. “*If motion is not detected*, spectral estimation on the signals is *carried out directly without motion artifact suppression*,” and “[i]n the case of motion, motion artifacts are suppressed using the motion artifact suppression module 580.” APPLE-1007, 47:52-56. In this way, Diab’s oximeter continuously operates by “comput[ing] the arterial and venous blood oxygen saturations of a physiological system on a *continuous* or nearly continuous time basis... regardless of whether or not the physiological system undergoes voluntary motion.” APPLE-1007, 34:10-12, 63:38-41, FIG. 11; APPLE-1003, ¶52. The “output filter 594” of the pulse rate module 410 provides “the pulse of the patient, which is advantageously provided to the display.” APPLE-1007, 48:3-5, 50:27-29.

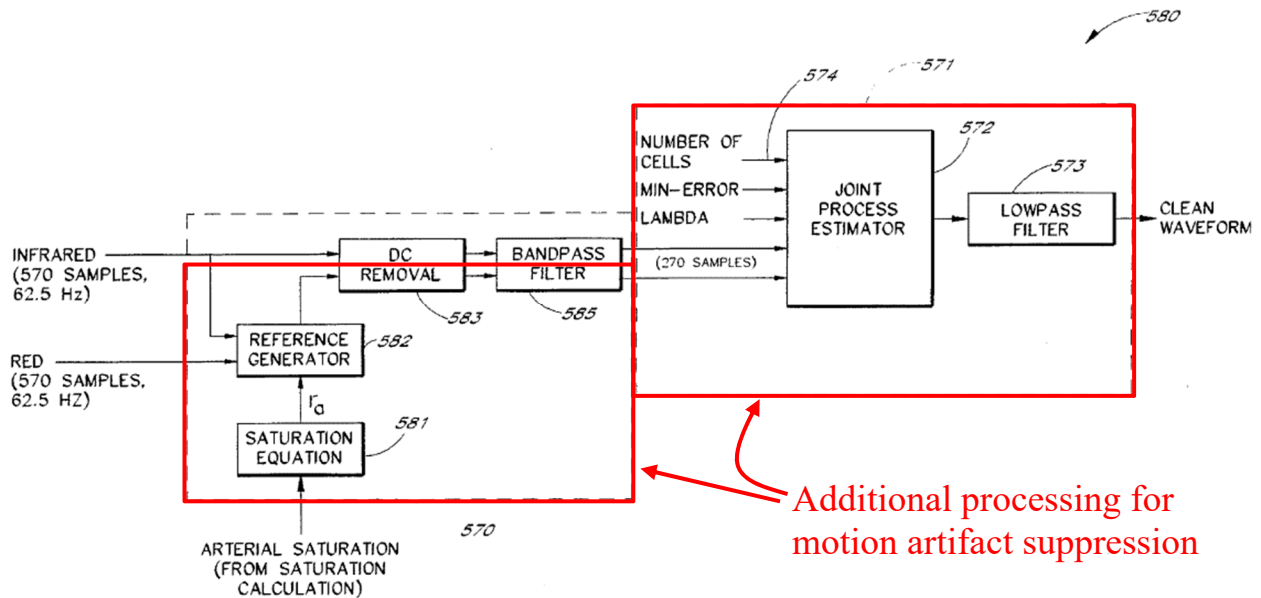
A functional diagram of Diab’s pulse rate module 410 is shown below, with annotations showing the signals (only infrared samples) and the modules 578, 586, 590, 592, and 594 used to determine the pulse rate “without motion artifact suppression” (green line) when motion is not detected by the motion status module 584. APPLE-1007, 48:6-33, 50:1-29; APPLE-1003, ¶53. As a comparison, the functional diagram is also annotated to show the signals (infrared samples, red samples, saturation value) and the motion artifact suppression module 580 (purple box) and modules 588, 590, 592, and 594 used to determine the pulse rate (purple

line) when motion is detected by the motion status module 584. APPLE-1007, 47:47-49, 47:55-50:29; APPLE-1003, ¶53.



APPLE-1007, Detail of FIG. 20 (annotated)

A functional diagram of the motion artifact suppression module 580 is shown below, with the additional processing for motion artifact suppression annotated. APPLE-1007, 48:34-49:32; APPLE-1003, ¶54.



APPLE-1007, Detail of FIG. 21 (annotated)

While Diab's explicit description that "[i]f motion is not detected, spectral estimation on the signals is carried out directly without motion artifact suppression" and "[i]n the case of motion, motion artifacts are suppressed using the motion artifact suppression module 580" (APPLE-1007, 47:52-56) teaches not executing the motion artifact suppression module 580 if motion is not detected, it would have also been obvious to suspend and not execute the operations of Diab's motion artifact suppression module 580 if motion is not detected based on Amano's teaching of suspending "the operations of... body movement component eliminating section" "when no body movement is present" (APPLE-1004, 21:65-22:6). APPLE-1003, ¶54.

Based at least on the teachings of Amano, a POSITA would have understood

that performing “spectral estimation on the signals... directly *without* motion artifact suppression” reduces power consumption based on Amano’s teaching that suspending “the operations of... body movement component eliminating section” reduces power consumption. APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1007, 48:34-49:38; APPLE-1003, ¶55. A POSITA would have been motivated and would have found it obvious and straightforward to combine Diab with Amano to “reduc[e] calculation time and power consumption,” as suggested by Amano, “[i]f motion is not detected” by performing “spectral estimation on the signals... directly *without* motion artifact suppression,” as taught by Diab. *Id.* Accordingly, the combination of Diab and Amano renders obvious continuously operating the oximeter at a lower power consumption level “[i]f motion is not detected” to determine measurement values for one or more physiological parameters of a patient. *Id.*

**9[d]: “comparing processing characteristics to a predetermined threshold; and”**

In the combination, Diab’s oximeter includes “red and infrared light emitters 301, 302 [that] each emits energy which is absorbed by the finger 310 and received by the photodetector 320” that “produces an electrical signal which corresponds to the intensity of the light energy striking the photodetector.” APPLE-1007, 35:23-27, 34:12-19. The signal processor 334 performs “a saturation transform,” which



is “an operation which converts the sample data from time domain to saturation domain values,” to provide “saturation transform power curve[s].” APPLE-1007, 35:34-47, 45:6-10. The signal processor 334 calculates “peak width of a power curve” where “[t]he width of the peaks provides some indication of motion by the patient—wider peaks indicating motion.” APPLE-1007, 46:13-20, 46:53-55. Accordingly, the red and infrared samples obtained from the photodetector signal are used to calculate the “peak width of a power curve.” APPLE-1007, 44:38-46:55; APPLE-1003, ¶56.

Diab’s signal processor 334 also performs functions of a “pulse rate module 410” that includes “a motion status module 584,” the output of which is provided to “a motion artifact suppression module 580.” APPLE-1007, 38:61-63, 47:30-38, 47:47-49, FIGS. 14, 20. An “average peak width value” (processing characteristics) is input to the “motion status module 584.” APPLE-1007, 47:50-52, FIG. 20. Diab teaches that “[t]he width of the peaks provides some indication of motion by the patient—wider peaks indicating motion” and “[i]f the peaks are wide, this is taken as an indication of motion.” APPLE-1007, 46:53-55, 47:51-52. As such, the motion status module 584 detects motion by determining “*if the peaks are wide.*” APPLE-1007, 47:50-56. A POSITA would have understood that in order to determine whether the peaks are “wide,” the “average peak width value” would be compared to a width value above which the peaks are considered “wide”

(a threshold). *Id.*; APPLE-1003, ¶57.

**9[e]: “when said processing characteristics pass said threshold, transitioning to continuously operating said patient monitor at a higher power consumption level,”**

As previously discussed (*supra* Ground 1A, 9[c]), Diab teaches that “[i]f *motion is not detected*, spectral estimation on the signals is *carried out directly without motion artifact suppression*,” and “[i]n the case of motion, *motion artifacts are suppressed* using the motion artifact suppression module 580.”

APPLE-1007, 47:52-56; APPLE-1003, ¶¶52-55. Based on Diab’s and Amano’s teachings as previously discussed (*supra*, Ground 1A, 9[p] and 9[c]), a POSITA would have found obvious that, during operation at the lower power consumption level “without motion artifact suppression,” when motion is detected based on processing characteristics (“average peak width value”) passing the threshold (a value corresponding to “wider peaks indicating motion”), the signal processor 334 transitions to the higher power consumption level where “motion artifacts are suppressed using the motion artifact suppression module 580.” APPLE-1007, 47:52-56; APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1003, ¶¶58, 46-50, 52-55. In the combination, Diab’s oximeter continuously operates by “comput[ing] the arterial and venous blood oxygen saturations of a physiological system on a *continuous* or nearly continuous time basis... regardless of whether or not the physiological system undergoes voluntary motion.” APPLE-1007, 34:10-12,

63:38-41, FIG. 11.

**9[f]: “wherein said continuously operating at said lower power consumption level comprises reducing an amount of processing by a signal processor.”**

As previously discussed, a POSITA would have found obvious that performing “spectral estimation on the signals... directly *without* motion artifact suppression,” as taught by Diab, reduces power consumption based on Amano’s teaching that suspending “the operations of... body movement component eliminating section” “reduc[es]... power consumption.” APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1007, 48:34-49:38; APPLE-1003, ¶61. As previously discussed (*supra* Ground 1A, 9[c]), a POSITA would have understood that Diab’s oximeter reduces the amount of processing by the signal processor when motion is not detected by processing less data (only infrared samples) and “without motion artifact suppression.” APPLE-1007, 47:52-56, 48:6-33, 50:1-29; APPLE-1003, ¶¶61, 52-55. Conversely, a POSITA also would have understood that Diab’s oximeter increases the amount of processing by the signal processor when motion is detected by processing more data (infrared samples, red samples, and saturation value) and “using the motion artifact suppression module 580.” APPLE-1007, 47:47-49, 47:55-50:29; APPLE-1003, ¶61. Also as previously discussed (*supra*, Ground 1A, 9[e]), the combination teaches that Diab’s oximeter continuously operates by “comput[ing] the arterial and venous blood oxygen saturations of a

physiological system on a *continuous* or nearly continuous time basis... regardless of whether or not the physiological system undergoes voluntary motion.” APPLE-1007, 34:10-12, 63:38-41, FIG. 11; APPLE-1003, ¶¶46-50, 52-55, 58.

Accordingly, in the combination, operating at the lower power consumption level by performing “spectral estimation on the signals... directly without motion artifact suppression” includes reducing an amount of processing because the signal processor processes less data (only infrared samples) and “without motion artifact suppression.” APPLE-1007, 47:52-56, 48:6-33, 50:1-29; APPLE-1003, ¶62.

## **6. Claim 10**

**10. The method of claim 9, wherein said reducing comprises processing less data.**

As previously discussed (*supra*, Ground 1A, 9[f]), the combination of Diab and Amano teaches reducing an amount of processing, including the signal processor processes less data (only infrared samples) and “without motion artifact suppression.” APPLE-1007, 47:52-56, 48:6-33, 50:1-29; APPLE-1003, ¶¶61-63, 46-50, 52-55, 58.

## **7. Claim 12**

**12[p]: “A method of managing power consumption during continuous patient monitoring by adjusting behavior of a patient monitor, the method comprising:”**

*Supra*, Ground 1A, 9[p]; APPLE-1003, ¶¶46-50.

**12[a]: “driving one or more light sources configured to emit light into tissue of a monitored patient;”**

**12[b]: “receiving one or more signals from one or more detectors configured to detect said light after attenuation by said tissue;”**

*Supra*, Ground 1A, 9[a]-9[b]; APPLE-1003, ¶51.

**12[c]: “continuously operating a patient monitor at a lower power consumption level to determine measurement values for one or more physiological parameters of a patient;”**

*Supra*, Ground 1A, 9[c]; APPLE-1003, ¶52-55.

**12[d]: “comparing processing characteristics to a predetermined threshold; and”**

*Supra*, Ground 1A, 9[d]; APPLE-1003, ¶¶56-57.

**12[e]: “when said processing characteristics pass said threshold, transitioning to continuously operating said patient monitor at a higher power consumption level,”**

*Supra*, Ground 1A, feature 9[e]; APPLE-1003, ¶¶46-50, 52-55, 58.

**12[f]: “wherein said processing characteristics include an override condition.”**

As previously discussed (*supra* Ground 1A, 9[d]), in the combination, Diab teaches comparing processing characteristics (“average peak width value”) to a predetermined threshold (a value corresponding to “wider peaks indicating motion”). APPLE-1007, 47:50-56; APPLE-1003, ¶¶56-57. “If motion is not detected, spectral estimation on the signals is carried out directly without motion artifact suppression,” and “[i]n the case of motion, motion artifacts are suppressed

using the motion artifact suppression module 580.” APPLE-1007, 47:52-56.

Based on Diab’s and Amano’s teachings as previously discussed (*supra*, Ground 1A, 9[p] and 9[c]), a POSITA would have found obvious that, during operation at the lower power consumption level “without motion artifact suppression,” when motion is detected based on processing characteristics (“average peak width value”) passing the threshold (a value corresponding to “wider peaks indicating motion”), the signal processor 334 transitions to the higher power consumption level where “motion artifacts are suppressed using the motion artifact suppression module 580.” APPLE-1007, 47:52-56; APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1003, ¶59, 46-50, 52-55.

A POSITA would have understood that when motion is present, the detected condition *overrides* the reduced power consumption state (where the signal processor processes only infrared samples “without motion artifact suppression”) causing the oximeter to continuously operate at a higher power consumption level where the signal processor processes more data (red samples and saturation value in addition to infrared samples) using the “motion artifact suppression module 580.” *Id.*; APPLE-1003, ¶60. Accordingly, the processing characteristics (“average peak width value”) passing the threshold (a value corresponding to “wider peaks indicating motion”) is an override condition that overrides the reduced power consumption state. *Id.*

**8. Claim 13**

**13. The method of claim 12, wherein said override condition comprises measurements during a critical care environment.**

In the combination, Diab's oximeter "provides clean plethysmographic waveforms of the detected signals and provides values for oxygen saturation and pulse rate to the display." APPLE-1007, 35:34-47, 34:24-28, FIGS. 13-14. A POSITA would have found it obvious to use Diab's oximeter to obtain "blood oxygen saturation, heart rate, and a clean plethysmographic waveform" during critical care of a patient in a critical care environment; doing so was contemplated by POSITAs at the time of the '703 Patent. *See, e.g.*, APPLE-1005, 1:67-2:10; APPLE-1014, 2:11-18; APPLE-1003, ¶64. In its description of the prior art in the background section, the '703 patent itself admits that using pulse oximetry devices to obtain measurements during a critical care environment were well known. APPLE-1001, 1:18-23. Obtaining the "blood oxygen saturation, heart rate, and a clean plethysmographic waveform" during critical care would include obtaining measurements indicating whether the override condition, e.g., the processing characteristic ("average peak width value") passing a predetermined threshold (a value corresponding to "wider peaks indicating motion"), exists to control the oximeter to operate at either the lower power consumption level or the higher power consumption level. APPLE-1007, 35:34-47, 34:24-28, 47:50-56; APPLE-

1003, ¶64.

## 9. Claim 14

**14. The method of claim 12, wherein said override condition comprises one or more monitored parameters exhibiting predefined behavior.**

As previously discussed (*supra* Ground 1A, 12[f]), in the combination, Diab teaches that the processing characteristic (“average peak width value”) passing a predetermined threshold (a value corresponding to “wider peaks indicating motion”) is an override condition that overrides operation at the lower power consumption level. APPLE-1003, ¶¶46-50, 52-57, 59-60; APPLE-1007, 47:50-56. As such, the override condition includes a monitored parameter exhibiting a predefined behavior, e.g., the processing characteristic (“average peak width value”) passing a predetermined threshold (a value corresponding to “wider peaks indicating motion”). *Id.*; APPLE-1003, ¶65.

## 10. Claim 20

**20[p]: “A patient monitor configured to manage power consumption during continuous patient monitoring, the monitor comprising:”**

*Supra*, Ground 1A, 9[p]; APPLE-1003, ¶¶46-50.

**20[a]: “an input configured to receive at least one signal responsive to light detected after attenuation by body tissue of a patient by a noninvasive sensor; and”**

*Supra*, Ground 1A, 9[a]-9[b]; APPLE-1003, ¶51.



**20[b]: “one or more processors continuously operating at a lower power consumption level to determine measurement values for one or more physiological parameters of said patient,”**

*Supra*, Ground 1A, 9[c]; APPLE-1003, ¶52-55.

**20[c]: “said processors comparing processing characteristics to a predetermined threshold, and”**

*Supra*, Ground 1A, 9[d]; APPLE-1003, ¶¶56-57.

**20[d]: “when said processing characteristics pass said threshold, said processors transitioning to continuously operating at a higher power consumption level,”**

*Supra*, Ground 1A, 9[e]; APPLE-1003, ¶¶46-50, 52-55, 58.

**20[e]: “wherein said processors reduce an amount of processing by a signal processor.”**

*Supra*, Ground 1A, 9[f]; APPLE-1003, ¶¶61-62, 46-50, 52-55, 58.

## **11. Claim 22**

**22[p]: “A patient monitor configured to manage power consumption during continuous patient monitoring, the monitor comprising:”**

*Supra*, Ground 1A, 9[p]; APPLE-1003, ¶¶46-50.

**22[a]: “an input configured to receive at least one signal responsive to light detected after attenuation by body tissue of a patient by a noninvasive sensor; and”**

*Supra*, Ground 1A, 9[a]-9[b]; APPLE-1003, ¶51.

**22[b]: “one or more processors continuously operating at a lower power consumption level to determine measurement values for one or more physiological parameters of said patient,”**

*Supra*, Ground 1A, 9[c]; APPLE-1003, ¶52-55.

**22[c]: “said processors comparing processing characteristics to a predetermined threshold, and”**

*Supra*, Ground 1A, feature 9[d]; APPLE-1003, ¶¶56-57.

**22[d]: “when said processing characteristics pass said threshold, said processors transitioning to continuously operating at a higher power consumption level,”**

*Supra*, Ground 1A, feature 9[e]; APPLE-1003, ¶¶46-50, 52-55, 58.

**22[e]: “wherein said processing characteristics include an override condition.”**

*Supra*, Ground 1A, feature 12[f]; APPLE-1003, ¶¶46-50, 52-57, 59-60.

## **12. Claim 23**

**23. The monitor of claim 22, wherein said override condition comprises measurements during a critical care environment.**

*Supra*, Ground 1A, Claim 13; APPLE-1003, ¶64.

## **13. Claim 24**

**24. The monitor of claim 22, wherein said override condition comprises one or more monitored parameters exhibiting predefined behavior.**

*Supra*, Ground 1A, Claim 14; APPLE-1003, ¶¶46-50, 52-57, 59-60, 65.

**B. GROUND 1B: Claims 11 and 21 are obvious based on Diab, Amano, and Edgar**

**1. Overview of Edgar**

Edgar describes operating a pulse oximeter to remove motion-induced noise artifacts or other similar artifacts from a measured waveform representative of a patient's arterial pulse. APPLE-1005, 2:28-42, 5:1-9, 6:15-18; APPLE-1003, ¶66. The pulse oximeter acquires "a segment of data (e.g., five or more pulses or approximately ten seconds)" measured from a light source transmitted through a finger and detected with a sensor. APPLE-1005, 6:42-46, 6:61-63. The data segment is subsegmented into its consecutive individual heartbeat pulses. APPLE-1005, 7:66-8:2.

If there is not sufficient noise in the data segment, only the latest pulse of the data segment is used for calculating arterial oxygen saturation. APPLE-1005, 8:48-62, 11:42-45, FIG. 11 (steps 230, 250). If there is sufficient noise in the data segment, the subsegments representing individual pulses of the data segment are combined to create an average pulse that is used for calculating arterial oxygen saturation. APPLE-1005, 8:48-62, 9:56-10:28, 11:34-36, 11:42-45, FIG. 11 (steps 230, 240). When data for a new pulse is obtained, data for the oldest pulse is removed from the segment of data, and the processing is repeated to calculate a new arterial oxygen saturation value for the new pulse. APPLE-1005, 11:45-52,

FIG. 7; APPLE-1003, ¶67.

## 2. The Combination of Diab, Amano, and Edgar

To the above-noted combination of Diab with Amano for providing “*the pulse of the patient*,” Edgar’s teachings would be added to offer an improved technique for removing motion artifacts from a measured signal used to calculate “*blood oxygen saturation*.” APPLE-1003, ¶¶68-69; APPPLE-1007, 48:3-5, 50:27-29; APPLE-1005, 1:64-2:10, 3:58-4:6, 5:1-4. In particular, Edgar explains that Diab’s approach to “removing motion artifacts from measured physiological signals” “is to first generate a noise reference signal from the two measured signals, and then use the noise reference signal as an input to an adaptive noise canceler along with either or both of the measured signals to remove the reference noise signal from the measured signals.” APPLE-1005, 3:58-4:6. Edgar provides a technique that “eliminate[s] motion-induced noise artifacts from light signals, that is relatively simple computationally, and that does not require more than one sensor.” APPLE-1005, 5:1-11. A POSITA would have recognized that the predictable modification of Diab (when combined with Amano) as suggested by Edgar would include implementing Edgar’s technique, instead of Diab’s technique that Edgar seeks to improve upon, for calculating “blood oxygen saturation” in the combined device. APPLE-1005, 3:58-4:6; APPLE-1003, ¶69.

### **3. Reasons to Combine Diab, Amano, and Edgar**

A POSITA would have been motivated and would have found it obvious and straightforward to combine Diab, Amano, and Edgar to achieve a pulse oximeter as described above (*supra*, Section III.B.2). APPLE-1003, ¶¶68-70; APPLE-1005, 2:28-42, 5:1-9, 6:15-18, 8:48-62, 9:56-10:28, 11:34-36, 11:42-45, FIG. 11. Diab, Amano, and Edgar are in the same field of art and relate to eliminating motion-induced noise from a measured physiological signal. APPLE-1004, 21:9-20, 21:37-46, 33:63-67, 34:3-15, 35:17-21, 38:23-26; APPLE-1005, 2:28-42, 5:1-9, 6:15-18; APPLE-1007, 2:23-26, 2:53-3:9, 34:1-9. Diab describes calculating blood oxygen saturation, and Edgar teaches calculating blood oxygen saturation using data from a single pulse or data from an average of multiple pulses depending on the level of noise in a data segment. APPLE-1007, 33:23-35, 39:25-30, FIG. 14 (module 408); APPLE-1005, 8:48-62, 11:42-45, FIG. 11 (steps 230, 240, 250). A POSITA would have been motivated to implement Edgar's teaching in Diab's oximeter (as supplemented with Amano's teachings) to provide an oximeter that eliminates motion-induced noise artifacts when calculating arterial oxygen saturation by using data from a single pulse when the noise level in a data segment is low or data from an average of multiple pulses when the noise level in a data segment is high, which is a relatively simple computation as compared to Diab's. APPLE-1005, 5:1-11; APPLE-1003, ¶71.

Further, a POSITA would have found it obvious to modify Diab (as supplemented with Amano's teachings) with Edgar because doing so entails the use of known techniques to improve similar systems and methods in the same way. APPLE-1003, ¶72. "[W]hen a patent 'simply arranges old elements with each performing the same function it had been known to perform' and yields no more than one would expect from such an arrangement, the combination is obvious." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). A POSITA would have recognized that applying Edgar's teachings to Diab's oximeter (as supplemented with Amano's teachings) would have led to predictable results without significantly altering or hindering the functions performed by the combined system. APPLE-1003, ¶72. In fact, a POSITA would have been motivated to provide the well-known technique of calculating blood oxygen saturation using data from a single pulse or data from an average of multiple pulses depending on the level of noise in a data segment to cause the combined apparatus to include such features to achieve the predictable benefits offered by Edgar's description of the same. *Id.*; see, e.g., APPLE-1004, 36:23-27, 38:26-27; APPLE-1005, 2:22-24, 8:48-62, 11:42-45, FIG. 11 (steps 230, 240, 250).

Indeed, a POSITA would have had a reasonable expectation of success in making this modification, and would have reasonably expected to reap benefits of calculating blood oxygen saturation from a measured waveform representative of a

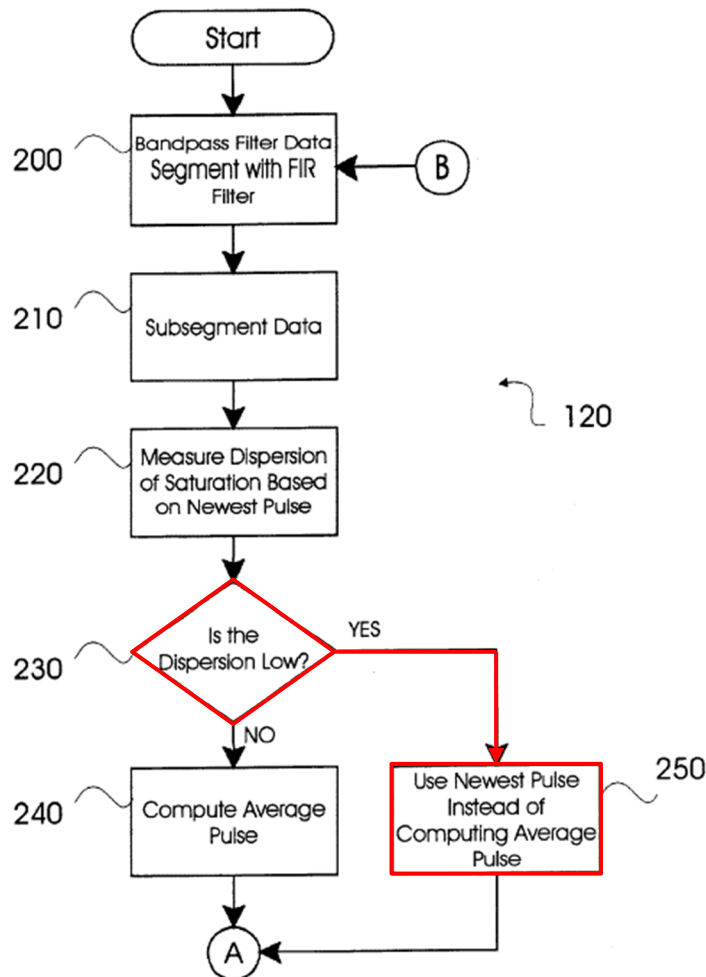
patient's arterial pulse. APPLE-1003, ¶73. Diab, Amano, and Edgar describe types of devices that provide pulse waveforms and, in combination, Edgar's features are implemented in Diab's oximeter (as supplemented with Amano's teachings) just as it is in Edgar's oximeter. *Id.*; *see, e.g.*, APPLE-1004, 36:23-27, 38:26-27; APPLE-1005, 2:22-24, 8:48-62, 11:42-45, FIG. 11 (steps 230, 240, 250); APPLE-1007, 34:27-28, 35:44-47, 49:25-32. Accordingly, implementing Edgar's teaching of calculating blood oxygen saturation in Diab's oximeter (as supplemented with Amano's teachings) would have been routine and straightforward to a POSITA, and it would have been clear that such a combination would predictably work and provide the expected functionality. *Id.*

#### **4. Claim 11**

##### **11. The method of claim 10, wherein said processing less data comprises reducing an overlap in data blocks being processed.**

As previously discussed (*supra* Ground 1A, 9[f]), the combination of Diab and Amano renders obvious operating at the lower power consumption level by performing "spectral estimation on the signals... directly without motion artifact suppression" when motion is not detected, which includes reducing an amount of processing because the signal processor processes less data (only infrared samples) and "without motion artifact suppression." APPLE-1007, 47:52-56, 48:6-33, 50:1-29; APPLE-1003, ¶¶74, 61-62, 46-50, 52-55, 58.

In the present combination, Edgar describes measuring dispersion to “determine whether there is sufficient noise in the data segment to warrant additional signal processing.” APPLE-1005, 8:48-50. “[W]here the dispersion is very low,” indicating that noise is low, “the use of previous data in combination with the latest pulse would not be required, see blocks 230 and 250 of FIG. 11” reproduced and annotated below. APPLE-1005, 8:50-53, FIG. 11 (steps 230, 250).



APPLE-1005, FIG. 11 (color added)

Accordingly, Edgar teaches processing less data when the motion-induced noise



level is low by using data from only the latest pulse to calculate arterial oxygen saturation. APPLE-1005, 8:48-62, 11:42-45, FIG. 11 (steps 230, 250); APPLE-1003, ¶75. A POSITA would have understood that there is no overlap in data being processed when using data from only the latest pulse. *Id.*

This is in contrast to Edgar's processing of more data that is performed when the noise level is high. APPLE-1003, ¶76. In particular, Edgar "begins with acquiring a segment of data (e.g., five or more pulses or approximately ten seconds) measured from a single light source transmitted through a finger and detected with a sensor." APPLE-1005, 6:42-46. "Where the dispersion is higher," indicating that noise is high, "the pulses for the time interval being evaluated may be combined to create an average pulse, see blocks 230 and 240 of FIG. 11." APPLE-1005, 8:53-56, 9:56-10:28, FIG. 11 (steps 230, 240). "The above methods may be repeated once another full heartbeat pulse of data is collected for both the red and IR signals, see block 140 of FIG. 1." APPLE-1005, 11:45-48. "The new pulse of data is added to the red and IR segments, respectively, and the oldest pulse of data is removed." APPLE-1005, 11:48-52, FIG. 7.

A POSITA would have understood that repeating the processing for a high noise level results in an overlap of data subsegments that are processed to calculate the blood oxygen saturation because data of the four previous pulses are repeatedly processed to create an average pulse. APPLE-1003, ¶77; *see, e.g.*, APPLE-1005,

6:42-46, 8:53-56, 9:56-10:28, 11:45-48, FIG. 11 (steps 230, 240). Accordingly, Edgar teaches that processing less data when the noise level is low includes reducing an overlap (e.g., no overlap) of data blocks being processed as compared with the overlap of data blocks (e.g., 4 data subsegments) processed when the noise level is high. APPLE-1005, 6:42-46, 8:48-62, 9:56-10:28, 11:42-48, FIG. 11 (steps 230, 240, 250); APPLE-1003, ¶77.

A POSITA would have recognized that the predictable modification of Diab (as supplemented with Amano's teachings) based on Edgar would include calculating arterial oxygen saturation by processing data of only the latest pulse, thereby processing less data as a result of no overlap in the data, when the noise level is low and by combining the pulses for the time interval being evaluated to create an average pulse, thereby processing more data as a result of overlapping data subsegments, when the noise level is high. APPLE-1003, ¶78; APPLE-1005, 6:42-46, 8:48-62, 9:56-10:28, 11:42-48, FIG. 11 (steps 230, 240, 250). Thus, the oximeter of the combination of Diab, Amano, and Edgar would process less data while operating at the lower power consumption level when motion is not detected by (1) performing "spectral estimation on the signals... directly without motion artifact suppression," which includes the signal processor processing less data (only infrared samples) and "without motion artifact suppression," to calculate pulse rate, and (2) by using data from only the latest pulse to calculate blood

oxygen saturation. *Id.*; APPLE-1007, 47:52-56, 48:6-33, 50:1-29.

## **5. Claim 21**

**21. The monitor of claim 20, wherein said processors reduce an overlap in data blocks being processed.**

*Supra*, Ground 1B, Claim 11; APPLE-1003, ¶¶74-78, 61-62, 46-50, 52-55, 58.

### **C. GROUND 1C: Claims 1-7 and 15-18 are obvious based on Diab, Amano, and Turcott**

#### **1. Overview of Turcott**

Similar to Diab, Turcott describes a pulse oximeter having a light source, including red and infrared LEDs, and a light detector, such as a photodetector. APPLE-1006, 11:15-41; yAPPLE-1003, ¶79. The light source is driven with a pulse train. APPLE-1006, 11:51-61. Turcott describes that “[t]he optical power generated by the [light] source is adjusted to optimize the signal to noise ratio and to minimize power consumption” by adjusting “the drive current” or “the duty cycle of the pulse train,” and “[t]o conserve energy, the [light] source is preferably driven with a low duty cycle pulse train.” APPLE-1006, 11:51-59.

#### **2. The Combination of Diab, Amano, and Turcott**

Diab describes that the “signal processing system 334 also provides control for driving the light emitters 301, 302 with an emitter current control signal on the

emitter current control output 337” and that “the current could be adjusted for changes in the ambient room light and other changes which would [a]ffect the voltage input to the front end analog signal conditioning circuitry 330.” APPLE-1007, 35:50-53, 36:2-6. In the combination, the modification of Diab’s oximeter (as supplemented with Amano’s teachings) would include implementing the signal processor 334 to reduce the duty cycle of the light emitters to further minimize power consumption of the combined device based on Turcott’s teaching of reducing the duty cycle to lower power consumption. APPLE-1003, ¶80; APPLE-1006, 11:54-59.

### **3. Reasons to Combine Diab, Amano, and Turcott**

A POSITA would have been motivated and would have found it obvious and straightforward to combine Diab, Amano, and Turcott to achieve a patient monitor that further increases the signal-to-noise ratio and further reduces power consumption. APPLE-1003, ¶81; APPLE-1004, 21:50-53, 22:4-6, 35:54-64; APPLE-1006, 11:54-59. Diab, Amano, and Turcott are in the same field of art and relate to devices that provide pulse waveforms. APPLE-1004, 21:3-8, 29:23-25, 31:2-8, 33:50-54, 34:3-14, 35:17-21, 36:23-27, 38:26-27, 40:23-27; APPLE-1006, 11:15-41; APPLE-1007, 34:27-28, 35:44-47, 49:25-32. Both Amano and Turcott disclose a need to optimize the signal-to-noise ratio and minimize power consumption. APPLE-1004, 21:50-53, 22:4-6, 35:54-64; APPLE-1006, 11:54-59.

Turcott teaches that reducing the duty cycle of the light source optimizes the signal-to-noise ratio and minimizes power consumption. APPLE-1006, 11:54-59.

A POSITA would have been motivated to implement Turcott's teaching of reducing the duty cycle to lower power consumption in a pulse oximeter in Diab's oximeter (as supplemented with Amano's teachings) to further minimize power consumption of the combined device. APPLE-1003, ¶81; APPLE-1006, 11:54-59. A POSITA would have understood further minimizing power consumption in the combined device to be desirable because further minimization would lead to longer battery life. *Id.*

Further, a POSITA would have found it obvious to modify Diab (as supplemented with Amano's teachings) with Turcott because doing so entails the use of known techniques and solutions to improve similar systems and methods in the same way. APPLE-1003, ¶82; *KSR*, 550 U.S. at 417. A POSITA would have recognized that applying Turcott's teachings to Diab (as supplemented with Amano's teachings) would have led to predictable results without significantly altering or hindering the functions performed by the oximeter. APPLE-1003, ¶82. In fact, a POSITA would have been motivated to provide the well-known technique of reducing the duty cycle to lower power consumption to cause the combined device to include such features to achieve the predictable benefits offered by Turcott's description of the same. *Id.*; APPLE-1006, 11:54-59.

Indeed, a POSITA would have had a reasonable expectation of success in making this modification (e.g., because Turcott describes a device operating in the proposed manner), and would have reasonably expected to reap benefits of reducing the duty cycle to lower power consumption. *Id.*; APPLE-1003, ¶83. Diab, Amano, and Turcott describe types of devices that provide pulse waveforms and, in combination, Turcott's features is implemented in Diab's oximeter (as supplemented with Amano's teachings) just as it is in Turcott's oximeter. *Id.* Accordingly, implementing Turcott's teaching of reducing the duty cycle of light sources to minimize power consumption, to operate a device as taught by Diab (as supplemented with Amano's teachings), would have been routine and straightforward to a POSITA, and it would have been clear that such a combination would predictably work and provide the expected functionality. *Id.*

#### 4. Claim 1

**1[p]: "A method of managing power consumption during continuous patient monitoring by adjusting behavior of a patient monitor, the method comprising:"**

*Supra*, Ground 1A, 9[p]; APPLE-1003, ¶¶46-50.

**1[a]: "driving one or more light sources configured to emit light into tissue of a monitored patient;"**

**1[b]: "receiving one or more signals from one or more detectors configured to detect said light after attenuation by said tissue;"**

*Supra*, Ground 1A, 9[a]-9[b]; APPLE-1003, ¶51.

**1[c]: “continuously operating a patient monitor at a lower power consumption level to determine measurement values for one or more physiological parameters of a patient;”**

*Supra*, Ground 1A, 9[c]; APPLE-1003, ¶52-55.

**1[d]: “comparing processing characteristics to a predetermined threshold; and”**

*Supra*, Ground 1A, 9[d]; APPLE-1003, ¶¶56-57.

**1[e]: “when said processing characteristics pass said threshold, transitioning to continuously operating said patient monitor at a higher power consumption level,”**

*Supra*, Ground 1A, 9[e]; APPLE-1003, ¶¶46-50, 52-55, 58.

**1[f]: “wherein said continuously operating at said lower power consumption level comprises reducing activation of an attached sensor,”**

In the combination, Diab describes that the “signal processing system 334 also provides control for driving the light emitters 301, 302 with an emitter current control signal on the emitter current control output 337.” APPLE-1007, 35:50-53. Diab also teaches that “the current could be adjusted for changes in the ambient room light and other changes which would [a]ffect the voltage input to the front end analog signal conditioning circuitry 330.” APPLE-1007, 36:2-6; APPLE-1003, ¶84.

Also in the combination, Turcott describes a pulse oximeter where “[t]he optical power generated by the [light] source is adjusted to optimize the signal to noise ratio and to minimize power consumption” by adjusting “the drive current,

the frequency of the pulse train, the pulse duration, or the duty cycle of the pulse train,” and “[t]o conserve energy, the [light] source is preferably driven with a low duty cycle pulse train.” APPLE-1006, 11:51-59; APPLE-1003, ¶85. A POSITA would have recognized that the predictable modification of Diab (as supplemented with Amano’s teachings) as suggested by Turcott would include implementing the oximeter’s signal processor to reduce the drive current or the duty cycle of the pulse train of the LEDs when the oximeter is operating at the lower power consumption level, further minimizing power consumption. *Id.*; APPLE-1006, 11:51-59.

In the combination, operating the LEDs of Diab with a reduced duty cycle reduces the activation of the LEDs under the proper construction of “reducing activation.” APPLE-1003, ¶86; APPLE-1006, 11:51-59. For example, a reduced duty cycle means that the power signal spends more time in each cycle in the “off” state, leading to a reduction in the portion of each cycle during which the LEDs are “activated.” *Id.* Additionally, under a broader construction of “reducing activation,” a reduced drive current means that the amount of current used to activate the LEDs is reduced, leading to reduced activation of the LEDs. *Id.* Accordingly, the combination of Diab, Amano, and Turcott teaches that continuously operating at the lower power consumption state includes the signal processor reducing activation of an attached sensor by reducing the duty cycle



(under the proper construction) or drive current (under a broader construction) of the LEDs. *Id.*

**1[g]: “said sensor positioning said light sources and said detectors proximate said tissue.”**

*Supra*, Ground 1A, 9[a]-9[b]; APPLE-1003, ¶51.

## **5. Claim 2**

**2. The method of claim 1, wherein said reducing activation comprises reducing a duty cycle of said sensor.**

*Supra*, Ground 1C, 1[f]; APPLE-1003, ¶¶84-86.

## **6. Claim 3**

**3. The method of claim 1, wherein during said operating at said higher power consumption level, monitoring when said processing characteristics recedes from said threshold; and when receded, transitioning to continuously operating said patient monitor at said lower power consumption level.**

Based on Diab’s and Amano’s teachings as previously discussed (*supra*, Ground 1A, 9[p] and 9[c]), a POSITA would have found obvious that, during operation at the higher power consumption level “using the motion artifact suppression module 580,” when motion is not detected based on processing characteristics (“average peak width value”) passing the threshold (a value corresponding to “wider peaks indicating motion”), the signal processor 334 transitions to the lower power consumption level where “spectral estimation on the signals is *carried out directly without motion artifact suppression.*” APPLE-

1007, 47:52-56; APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1003, ¶¶87, 46-50, 52-55. In the combination, Diab’s oximeter continuously operates by “comput[ing] the arterial and venous blood oxygen saturations of a physiological system on a *continuous* or nearly continuous time basis... regardless of whether or not the physiological system undergoes voluntary motion.” APPLE-1007, 34:10-12, 63:38-41, FIG. 11.

#### **7. Claim 4**

**4. The method of claim 1, wherein said processing characteristics comprise signal characteristics from one or more light sensitive detectors.**

As previously discussed, the processing characteristics of Diab (the “average peak width value” of the power curve of the photodetector signal) are signal characteristics from one or more light sensitive detectors that indicate the presence of motion-induced noise in the detector signal. *Supra*, Ground 1A, 9[d]; APPLE-1003, ¶¶88, 56-57.

#### **8. Claim 5**

**5. The method of claim 4, wherein said signal characteristics comprise signal strength.**

In the combination, Diab’s signal processor 334 calculates “peak width of a power curve” where “[t]he width of the peaks provides some indication of motion by the patient—wider peaks indicating motion.” APPLE-1007, 46:13-20, 46:53-55. Accordingly, the “average peak width value” (processing characteristics)

obtained from a signal provided by a photodetector indicates a strength of motion-induced noise in the photodetector signal. APPLE-1003, ¶89.

Also in the combination, Turcott teaches that “[t]he optical power to the source is adjusted to optimize the signal to noise ratio.” APPLE-1006, 11:51-61. Accordingly, signal to noise ratio indicates strength of the signal as well as the noise. APPLE-1003, ¶90.

## **9. Claim 6**

**6. The method of claim 4, wherein said signal characteristics comprise a presence of noise.**

*Supra*, Ground 1C, Claim 4; APPLE-1003, ¶¶88, 56-57.

## **10. Claim 7**

**7. The method of claim 4, wherein said signal characteristics comprise a presence of motion induced noise.**

*Supra*, Ground 1C, Claim 4; APPLE-1003, ¶¶88, 56-57.

## **11. Claim 15**

**15[p]: “A patient monitor configured to manage power consumption during continuous patient monitoring, the monitor comprising:”**

*Supra*, Ground 1A, 9[p]; APPLE-1003, ¶¶46-50.

**15[a]: “an input configured to receive at least one signal responsive to light detected after attenuation by body tissue of a patient by a noninvasive sensor; and”**

*Supra*, Ground 1A, 9[a]-9[b]; APPLE-1003, ¶51.

**15[b]: “one or more processors continuously operating at a lower power consumption level to determine measurement values for one or more physiological parameters of said patient,”**

*Supra*, Ground 1A, 9[c]; APPLE-1003, ¶¶52-55.

**15[c]: “said processors comparing processing characteristics to a predetermined threshold, and”**

*Supra*, Ground 1A, 9[d]; APPLE-1003, ¶¶56-57.

**15[d]: “when said processing characteristics pass said threshold, said processors transitioning to continuously operating at a higher power consumption level,”**

*Supra*, Ground 1A, 9[e]; APPLE-1003, ¶¶46-50, 52-55, 58.

**15[e]: “wherein processors reduce activation of an attached sensor.”**

*Supra*, Ground 1C, 1[f]; APPLE-1003, ¶¶84-86.

## **12. Claim 16**

**16. The monitor of claim 15, wherein said processors reduce a duty cycle of said sensor.**

*Supra*, Ground 1C, 1[f]; APPLE-1003, ¶¶84-86.

## **13. Claim 17**

**17. The monitor of claim 15, wherein during said operating at said higher power consumption level, said processors monitors when said processing characteristics recedes from said threshold; and when receded, said processors transition to continuously operating at said lower power consumption level.**

*Supra*, Ground 1C, Claim 3; APPLE-1003, ¶¶87, 46-50, 52-55.

**14. Claim 18**

**18. The monitor of claim 15, wherein said processing characteristics comprise signal characteristics from one or more light sensitive detectors.**

*Supra*, Ground 1C, Claim 4; APPLE-1003, ¶¶88, 56-57.

**D. GROUND 2A: Claims 9-10, 12-14, 20, and 22-24 are obvious based on Diab and the GK-POSITA;  
GROUND 2B: Claims 11 and 21 are obvious based on Diab, the GK-POSITA, and Edgar;  
GROUND 2C: Claims 1-7 and 15-18 are obvious based on Diab, the GK-POSITA, and Turcott**

As articulated in Ground 1A, in light of Amano's teaching of reducing power consumption by suspending unnecessary processing operations, a POSITA would have found it obvious that Diab's oximeter likewise reduces power consumption by not performing motion artifact suppression when no motion is detected. APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1007, 47:52-56, 48:34-49:38; APPLE-1003, ¶91. Diab and Amano is a combination in which Amano is offered to demonstrate a broader concept that is well understood by a POSITA, namely that reducing the amount of processing by suspending operations reduces power consumption.

This concept is well known to a POSITA, and thus, for Grounds 2A-2C, the application of Diab alone reveals to a POSITA, based on their general knowledge and ordinary level of skill, that changes in power consumption were obvious from changes in the amount of processing that are contemplated by Diab. APPLE-1003,

¶92. This is corroborated by a number of references, such as U.S. Patent No. 5,027,410 (APPLE-1015, 10:62-65); U.S. Publication No. 2003/000442 (APPLE-1016, [0103]); U.S. Publication No. 2002/003238 (APPLE-1017, [0098]); U.S. Patent Application Publication No. 2003/0163287 (APPLE-1018, [0241]); U.S. Patent No. 6,163,721 (APPLE-1019, 2:25-27); U.S. Patent No. 5,058,203 (APPLE-1020, 1:10-12 and 2:23-25); U.S. Patent No. 6,711,691 (APPLE-1021, 1:59-61); and Amano. *Id.*

A POSITA would have further understood that Diab's oximeter reduces the amount of processing by the signal processor when motion is not detected by processing less data (only infrared samples) and "without motion artifact suppression," thereby reducing the power consumed by the processor. APPLE-1007, 47:52-56, 48:6-33, 50:1-29; APPLE-1003, ¶93. Conversely, a POSITA also would have understood that Diab's oximeter increases the amount of processing by the signal processor when motion is detected by processing more data (infrared samples, red samples, and saturation value) and "using the motion artifact suppression module 580." *Id.* As such, a POSITA would have recognized that reducing unnecessary processing reduces power consumption of the oximeter and increasing the amount of processing increases power consumption of the oximeter. *Id.* Accordingly, Diab's oximeter, by adjusting the amount of processing based on the presence or absence of motion, manages power consumption during continuous

patient monitoring. *Id.*

**E. GROUND 3A: Claims 9-10, 12-14, 20, and 22-24 are obvious based on Amano**

**1. Overview of Amano**

Amano describes a “pulse wave examination apparatus” that allows a subject to “detect his pulse condition continuously in his daily life.” APPLE-1004, 36:23-27, 38:26-27; APPLE-1003, ¶ 94. The pulse wave examination apparatus includes a “pulse wave detecting section 10” that detects the pulse waveform of the periphery of a subject. APPLE-1004, 21:3-8, 29:23-25, 31:2-8, 33:50-54, 34:3-14, 35:17-21, 40:23-27. Amano further describes that “body movement causes the blood flow of the subject to fluctuate,” and “a component due to the body movement is superimposed on the pulse waveform” output from the pulse wave detecting section 10, which can cause “difficulty in making an exact judgment of the pulse condition.” APPLE-1004, 33:54-63. Hence, the pulse wave examination apparatus also includes a judging section 22 that determines whether body movement is present by comparing the body movement detected by the body movement detecting section 20 with a threshold value. APPLE-1004, 21:57-65, 34:3-15, 35:54-59; APPLE-1003, ¶¶ 95-96. When the judging section 22 detects that no body movement is present, the operations of a waveform treating section 21 and a body movement eliminating section 30 are suspended and the pulse

waveform from the pulse wave detecting section 10 is output directly from the body movement eliminating section 30. APPLE-1004, 21:65-22:4, 35:54-64.

Amano discloses that suspending the operations of sections 21 and 30 when there is no body movement reduces power consumption of the apparatus. APPLE-1004, 21:50-53, 22:4-6, 35:54-64; APPLE-1003, ¶ 96.

As articulated in Ground 1A, the combination of Diab and Amano renders obvious limitations 9[d], 12[d], 15[c], 20[c], and 22[c] based, e.g., on Diab's detection of motion from a signal provided by a photodetector corresponding to the attenuated visible and infrared light energy signals and determining whether motion is present by comparing the "average peak width value" with a value corresponding to "wider peaks indicating motion." APPLE-1007, 34:10-20, 35:23-27, 44:38-46:55, 46:53-55, 47:51-56. In Ground 1A, these limitations are rendered obvious even under a limiting interpretation requiring "processing characteristics" to be obtained from a signal provided by a photodetector. APPLE-1003, ¶ 97.

For Grounds 3A-3B, these limitations are rendered obvious by Amano's disclosure of "an acceleration sensor [that] detects the body movement of a subject to output the detected signal as a signal TH" and a "judging section 22 [that] determines whether body movement is present or not, based on the body movement waveform TH, to yield a control signal C... by comparing a threshold value with the body movement waveform TH." APPLE-1004, 21:57-65, 34:3-15,



35:54-59. Amano renders obvious these limitations based on the plain meaning of “processing characteristics.” APPLE-1003, ¶98. Indeed, the plain meaning of “processing characteristics” includes characteristics or features obtained from or used for processing information, including Amano’s acceleration sensor output, which is used by Amano to provide a body movement waveform that used for processing of the pulse waveform. Id.; APPLE-1004, 21:9-49. Accordingly, Grounds 3A-3B rely on Amano’s teachings alone to satisfy the “processing characteristics” limitations.

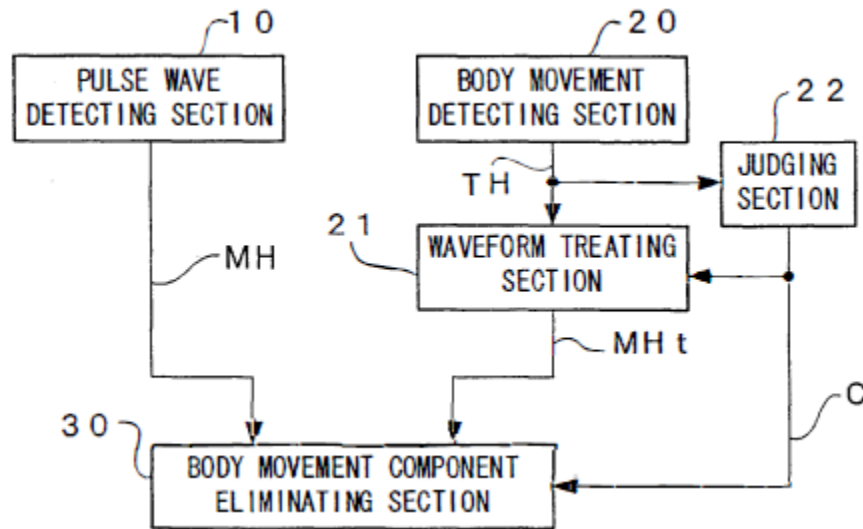
## **2. Claim 9<sup>3</sup>**

### **Limitation 9[p]**

Amano teaches a method for operating a “pulse wave examination apparatus” that allows a subject to “detect his pulse condition *continuously* in his daily life.” APPLE-1004, 36:23-27, 38:26-27; APPLE-1003, ¶¶99-100. A portion of the functional diagram of the apparatus is shown below:

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<sup>3</sup> For the sake of brevity, the remaining analysis will refer to the claim limitations by the identifiers listed in Grounds 1A-1C.



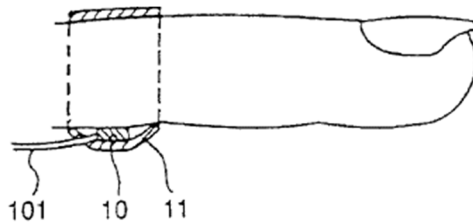
APPLE-1004, Detail of FIG. 1 (see also FIGS. 3, 24)

The pulse wave examination apparatus of Amano manages power consumption during continuous patient pulse monitoring by also including a “judging section 22 [that] determines whether body movement is present or not, based on the body movement waveform TH, to yield a control signal C... by comparing a threshold value with the body movement waveform TH.” APPLE-1004, 21:57-65, 34:3-15, 35:54-59; APPLE-1003, ¶101. “[W]hen the control signal C indicates that no body movement is present, the operations of the waveform treating section 21 and body movement component eliminating section 30 are suspended” and “the pulse waveform MH is output directly from the body movement component eliminating section 30.” APPLE-1004, 21:65-22:4, 35:54-64. Amano describes that suspending the operations of sections 21 and 30 when there is no body movement “can improve the SN ratio of the output signal from the

body movement component eliminating section 30 and reduce power consumption in the apparatus,” “thereby reducing calculation time and power consumption and improving the SN ratio.” *Id.*, 21:50-22:6, 35:54-64.

### Limitations 9[a]-9[b]

In the combination, Amano’s pulse wave detecting section 10 is “mounted on the root of a finger,” as shown in FIG. 37B reproduced below, and “can monitor the monitor parameters signifying blood pressure noninvasively.” APPLE-1004, 40:44-46, 2:46-50, 3:24-28; APPLE-1003, ¶102.



APPLE-1004, Detail of FIG. 37B

The pulse wave detecting section 10 includes an LED (a light source) and a phototransistor (a light detector). APPLE-1004, 41:12-13, FIG. 38; APPLE-1003, ¶103. When the pulse wave examination apparatus is powered on, light is emitted from the LED. APPLE-1004, 41:14-15. “The *emitted light is reflected*” (and then attenuated) “*by the blood vessel and tissues* of the subject and is then *received by the phototransistor*.” *Id.*, 41:15-17, 54:13-30.<sup>4</sup> “A combination of such a blue

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<sup>4</sup> All emphasis added unless otherwise indicated.

LED and a phototransistor ensures that a pulse wave is detected.” APPLE-1004.

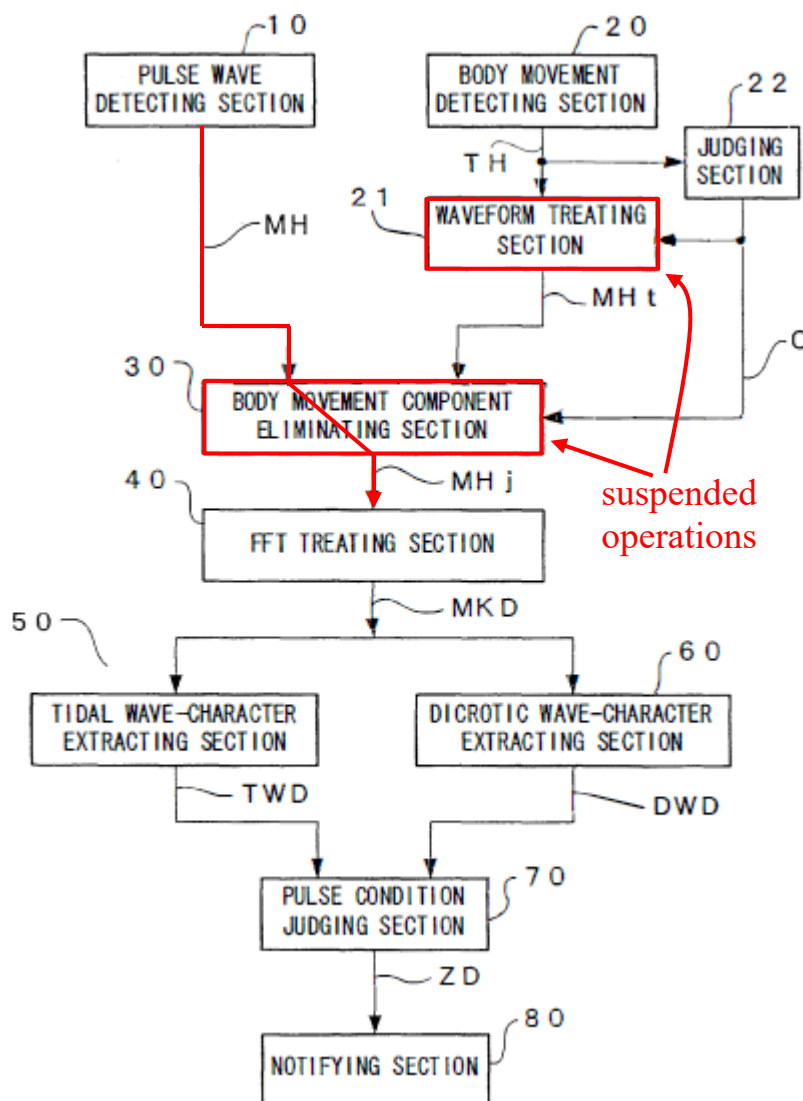
41:17-39; APPLE-1003, ¶103.

### **Limitation 9[c]**

Amano’s pulse wave examination apparatus allows a subject to “detect his pulse condition *continuously* in his daily life.” APPLE-1004, 36:23-27, 38:26-27. “[W]hen... no body movement is present, the operations of the waveform treating section 21 and body movement component eliminating section 30 are suspended” and “the pulse waveform MH is output directly from the body movement component eliminating section 30” to, for example, “an FFT treating section 40 [that] provides the signal MHj, showing a pulse wave component, with FFT treatment” shown in FIG. 1 below. APPLE-1004, 21:57-22:9, 34:3-15, 35:54-64, FIG. 1, *see also* FIGS. 3, 24. Amano describes that suspending the operations of sections 21 and 30 when there is no body movement “*reduce[s] power consumption* in the apparatus.” APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1003, ¶104.

A functional diagram of the apparatus from FIG. 1 of Amano, with the suspended operations of sections 21 and 30 annotated and with the pulse waveform MH output directly from the body movement component eliminating section 30 to the FFT treating section 40 annotated, is shown below. A POSITA would have understood that the sections other than sections 21 and 30 are continuously

operating to determine a pulse waveform and a pulse condition while sections 21 and 30 are suspended. APPLE-1003, ¶105; *see, e.g.*, APPLE-1004, 21:57-22:9, 34:3-15, 35:54-64, 36:23-27, 38:26-27, FIGS. 1, 3, 24.



APPLE-1004, Detail of FIG. 1 (annotated)

### Limitation 9[d]

Amano's pulse wave examination apparatus includes "an acceleration sensor

[that] detects the body movement of a subject to output the detected signal as a signal TH” and a “judging section 22 [that] determines whether body movement is present or not, based on the body movement waveform TH, to yield a control signal C... by *comparing a threshold value with the body movement waveform TH.*” APPLE-1004, 21:57-65, 34:3-15, 35:54-59. Accordingly, Amano teaches comparing processing characteristics (body movement waveform) to a predetermined threshold (threshold value). *Id.*; APPLE-1003, ¶106.

**Limitation 9[e]**

Amano teaches that “when... no body movement is present, the operations of the waveform treating section 21 and body movement component eliminating section 30 are suspended” and “the pulse waveform MH is output directly from the body movement component eliminating section 30.” APPLE-1004, 21:65-22:4, 35:54-64. Amano describes that suspending the operations of sections 21 and 30 when there is no body movement “reduce[s] power consumption in the apparatus.” APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1003, ¶107.

A POSITA would have understood that when body movement is detected (based on processing characteristics passing a predetermined threshold), the apparatus continuously operates and performs the operations of the “waveform treating section 21 [that] comprises, for instance, a low-pass filter, and performs waveform-shaping treatment of the signal TH output from the body movement

detecting section 20 to output a signal MHt showing a body movement component,” and the “body movement eliminating section 30 [that] subtracts the signal MHt showing a body movement component from the signal MH output from the pulse wave detecting section 10 to output a signal MHj showing a pulse wave component.” APPLE-1004, 21:9-20, 21:37-46, 33:63-67, 36:23-27, 38:23-27; APPLE-1003, ¶108. Performing the operations of sections 21 and 30 would lead to higher power consumption relative to the reduced power consumption when the operations of sections 21 and 30 are suspended. *Id.*; APPLE-1004, 21:50-22:6, 35:54-64.

**Limitation 9[f]**

As previously discussed (*supra* Ground 3A, 9[p] and 9[c]), Amano’s apparatus continuously operates at the lower power consumption level by suspending the operations of sections 21 and 30 when no body movement is detected. APPLE-1004, 21:50-22:4, 22:4-6, 34:3-15, 35:54-64, 36:23-27, 38:26-27; APPLE-1003, ¶¶99-101, 104-105. The “waveform treating section 21 comprises, for instance, a low-pass filter, and performs waveform-shaping treatment of the signal TH output from the body movement detecting section 20 to output a signal MHt showing a body movement component,” and the “body movement eliminating section 30 subtracts the signal MHt showing a body movement component from the signal MH output from the pulse wave detecting

section 10 to output a signal MHj showing a pulse wave component.” APPLE-1004, 21:9-20. As such, the operations of sections 21 and 30 perform processing on and output signals, including signal TH, signal MHt, signal MH, and signal MHj. APPLE-1003, ¶109; APPLE-1004, 21:9-20. Accordingly, suspending the operations of sections 21 and 30 would reduce the amount of processing performed, and power consumed, by Amano’s apparatus. *Id.*

Additionally, Amano’s pulse wave examination apparatus allows a subject to “detect his pulse condition continuously in his daily life.” APPLE-1004, 36:23-27, 38:26-27. A POSITA would have recognized that signal processors are commonly and advantageously used in physiological monitors to process and extract information from data signals continuously in real-time. *Id.*; APPLE-1003, ¶110 (citing APPLE-1005, 1:45-48; APPLE-1007, 1:31-35; APPLE-1014, 4:40-41). Thus, a POSITA would have found obvious that the operations of sections 21 and 30 are performed by a signal processor in order to allow the subject to “detect his pulse condition continuously in his daily life.” *Id.*; APPLE-1004, 36:23-27, 38:26-27. Accordingly, a POSITA would have found obvious that suspending the operations of sections 21 and 30 reduces an amount of processing by the signal processor performing the operations of sections 21 and 30. *Id.*; APPLE-1004, 21:9-20.



### **3. Claim 10**

As previously discussed (*supra* Ground 3A, 9[f]), Amano's apparatus reduces the amount of processing while the operations of sections 21 and 30 are suspended. APPLE-1003, ¶¶99-101, 104-105, 109-110; APPLE-1004, 21:50-22:4, 22:4-6, 34:3-15, 35:54-64, 36:23-27, 38:26-27. The "waveform treating section 21 comprises, for instance, a low-pass filter, and performs waveform-shaping treatment of the signal TH output from the body movement detecting section 20 to output a signal MHt showing a body movement component," and the "body movement eliminating section 30 subtracts the signal MHt showing a body movement component from the signal MH output from the pulse wave detecting section 10 to output a signal MHj showing a pulse wave component." APPLE-1004, 21:9-20. While the operations of sections 21 and 30 are suspended, the pulse wave signal is not filtered or treated by removing the body movement component, resulting in less data being processed. APPLE-1004, 21:50-22:4, 22:4-6, 34:3-15, 35:54-64, 36:23-27, 38:26-27; APPLE-1003, ¶114.

### **4. Claim 12**

#### **Limitations 12[p]-12[e]**

*Supra*, Ground 3A, 9[p]-9[e]; APPLE-1003, ¶¶99-108.

#### **Limitation 12[f]**

As previously discussed (*supra* Ground 3A, 9[d]), Amano teaches

comparing processing characteristics to a predetermined threshold to determine whether body movement is present in the waveform. APPLE-1004, 21:57-65, 34:3-15, 35:54-59; APPLE-1003, ¶106. In Amano, “when... no body movement is present, the operations of the waveform treating section 21 and body movement component eliminating section 30 are suspended” and “the pulse waveform MH is output directly from the body movement component eliminating section 30.” APPLE-1004, 21:65-22:4, 35:54-64. Amano teaches that suspending the operations of sections 21 and 30 when there is no body movement “reduce[s] power consumption in the apparatus.” APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1003, ¶111.

A POSITA would have understood that when body movement is present, the detected condition *overrides* the reduced power consumption state, causing the apparatus to continuously operate at a higher power consumption state and perform the operations of sections 21 and 30. APPLE-1004, 21:9-20, 21:37-46, 33:63-67, 36:23-27, 38:23-27; APPLE-1003, ¶112. Accordingly, the processing characteristic passing a predetermined threshold, indicating that body movement is present, is an override condition that overrides the reduced power consumption state. *Id.*

## 5. Claim 13

Amano teaches that “various types of medical information can be obtained

by the detection of pulse wave and analysis of the detected pulse wave... making a diagnosis possible on the basis of these types of information.” APPLE-1004, 1:19-27. Amano’s apparatus “can judge the pulse condition objectively and accurately.” APPLE-1004, 3:20-23; APPLE-1003, ¶115.

A POSITA would have found obvious that Amano’s apparatus could be used to obtain various types of medical information, e.g., the pulse condition, “objectively and accurately” during critical care of a patient in a critical care environment. APPLE-1003, ¶116 (citing APPLE-1005, 1:67-2:10; APPLE-1014, 2:11-18). In its description of the prior art in the background section, the ’703 patent itself admits that using pulse oximetry devices to obtain measurements during a critical care environment were well known. APPLE-1001, 1:18-23. Obtaining the pulse condition during critical care would include obtaining measurements indicating whether the override condition, e.g., the processing characteristic passing a predetermined threshold indicating motion is present, exists to control the operation of the apparatus in either the reduced power consumption state or the higher power consumption state. *Id.*; APPLE-1004, 1:19-27, 3:20-23; APPLE-1003, ¶116.

## **6. Claim 14**

As previously discussed (*supra* Ground 3A, 12[f]), the processing characteristic passing a predetermined threshold, indicating that body movement or

motion is present, is an override condition that overrides the reduced power consumption state. APPLE-1003, ¶¶106, 111-112; APPLE-1004, 21:9-20, 21:37-46, 33:63-67, 36:23-27, 38:23-27. As such, the override condition includes a monitored parameter exhibiting a predefined behavior, e.g., the processing characteristic (e.g., the accelerometer signal of Amano or the average peak width of Diab) passing a predetermined threshold indicating that body movement or motion is present. *Id.*; APPLE-1003, ¶117

## **7. Claim 20**

### **Limitation 20[p]**

*Supra*, Ground 3A, 9[p]; APPLE-1003, ¶¶99-101.

### **Limitation 20[a]**

*Supra*, Ground 3A, 9[a]-9[b]); APPLE-1003, ¶¶102-103.

### **Limitation 20[b]**

In addition to Amano's teachings previously discussed (*supra*, Ground 3A, [9c]; APPLE-1003, ¶¶104-105), Amano teaches that the pulse wave examination apparatus includes "CPUs, memories and the like" and "the CPU undergoes various calculating processes and comparing processes on the basis of control programs stored in part of the memories." APPLE-1004, 30:60-67, 41:4-6 ("a CPU controlling various calculations and transformations"). A POSITA would have understood that the "CPUs" (one or more processors) of Amano perform the

operations of the sections of the apparatus. APPLE-1003, ¶113; APPLE-1004, 30:60-67, 41:4-6.

**Limitation 20[c]**

*Supra*, Ground 3A, 9[d], 20[b]; APPLE-1003, ¶¶104-106, 113.

**Limitation 20[d]**

*Supra*, Ground 3A, 9[e], 20[b]; APPLE-1003, ¶¶107-108, 104-105, 113.

**Limitation 20[e]**

*Supra*, Ground 3A, 9[f], 20[b]; APPLE-1003, ¶¶99-101, 104-105, 109-110, 113.

**8. Claim 22**

**Limitation 22[p]-22[d]**

*Supra*, Ground 3A, 20[p]-20[d]; APPLE-1003, ¶¶99-105, 107-108, 113.

**Limitation 22[e]**

*Supra*, Ground 3A, 12[f]; APPLE-1003, ¶¶106, 111-112.

**9. Claim 23**

*Supra*, Ground 3A, Claim 13; APPLE-1003, ¶¶115-116.

**10. Claim 24**

*Supra*, Ground 3A, Claim 14; APPLE-1003, ¶¶106, 111-112, 117.

**F. GROUND 3B: Claims 1-3 and 15-17 are obvious based on Amano and Turcott**

**1. The Combination of Amano and Turcott**

In the combination, the modification of Amano's apparatus would include implementing the apparatus to reduce the duty cycle of the light emitter to further minimize power consumption of the combined device based on Turcott's teaching of reducing the duty cycle to lower power consumption. APPLE-1003, ¶118; APPLE-1006, 11:54-59.

**2. Reasons to Combine Amano and Turcott**

A POSITA would have been motivated and would have found it obvious and straightforward to combine Amano and Turcott to achieve a pulse wave examination apparatus that optimizes the signal-to-noise ratio and minimizes power consumption. APPLE-1003, ¶119; APPLE-1004, 21:50-53, 22:4-6, 35:54-64; APPLE-1006, 11:54-59. Both Amano and Turcott are in the same field of art and relate to pulse wave examination devices. APPLE-1004, 21:3-8, 29:23-25, 31:2-8, 33:50-54, 34:3-14, 35:17-21, 36:23-27, 38:26-27, 40:23-27; APPLE-1006, 11:15-41. Both Amano and Turcott disclose a need to optimize the signal-to-noise ratio and minimize power consumption. APPLE-1004, 21:50-53, 22:4-6, 35:54-64; APPLE-1006, 11:54-59. Turcott teaches that reducing the duty cycle of the light source optimizes the signal-to-noise ratio and minimizes power consumption.

APPLE-1006, 11:54-59. A POSITA would have been motivated to implement Turcott's teaching of reducing the duty cycle to lower power consumption in a pulse oximeter in combination with Amano's pulse wave examination apparatus to further minimize power consumption. APPLE-1003, ¶119; APPLE-1006, 11:54-59. A POSITA would have understood further minimizing power consumption in Amano's device to be desirable because further minimization would lead to longer battery life. *Id.*

Further, a POSITA would have found it obvious to modify Amano with Turcott because doing so entails the use of known solutions to improve similar systems and methods in the same way. APPLE-1003, ¶120; *KSR*, 550 U.S. at 417. A POSITA would have recognized that applying Turcott's teachings to Amano's pulse wave examination apparatus would have led to predictable results without significantly altering or hindering the functions performed by the pulse wave examination apparatus. APPLE-1003, ¶120. In fact, a POSITA would have been motivated to provide the well-known technique of reducing the duty cycle to lower power consumption to cause Amano's pulse wave examination apparatus to include such features to achieve the predictable benefits offered by Turcott's description of the same. *Id.*; APPLE-1006, 11:54-59.

Indeed, a POSITA would have had a reasonable expectation of success in making this modification, and would have reasonably expected to reap benefits of

reducing the duty cycle to lower power consumption. *Id.*; APPLE-1003, ¶121.

Amano and Turcott describe the same types of pulse waveform examination devices and, in combination, Turcott's features is implemented in Amano's pulse waveform examination apparatus just as it is in Turcott's pulse oximeter. *Id.*

Accordingly, implementing Turcott's teaching of reducing the duty cycle of light sources to minimize power consumption, to operate a pulse detector as taught by Amano, would have been routine and straightforward to a POSITA, and it would have been clear that such a combination would predictably work and provide the expected functionality. *Id.*

### **3. Claim 1**

#### **Limitations 1[p]-1[e]**

*Supra*, Ground 3A, 9[p]-9[e]; APPLE-1003, ¶¶99-108.

#### **Limitation 1[f]**

In the combination, Turcott describes a pulse oximeter where “[t]he optical power generated by the [light] source is adjusted to optimize the signal to noise ratio and to minimize power consumption” by adjusting “the drive current, the frequency of the pulse train, the pulse duration, or the duty cycle of the pulse train,” and “[t]o conserve energy, the [light] source is preferably driven with a low duty cycle pulse train.” APPLE-1006, 11:51-59; APPLE-1003, ¶122.

A POSITA would have recognized that the predictable modification of



Amano as suggested by Turcott would include implementing the apparatus to reduce the drive current or the duty cycle of the pulse train of the LED, further minimizing power consumption. APPLE-1003, ¶123; APPLE-1006, 11:51-59. When the apparatus is operating in the lower power consumption state, the apparatus also reduces the drive current or the duty cycle of the pulse train of the LED to further minimize power consumption. *Id.*

Operating the LED of Amano with a reduced drive current or duty cycle reduces the activation of the LED. APPLE-1003, ¶124. For example, a reduced duty cycle means that the power signal spends more time in each cycle in the “off” state, leading to a reduction in the portion of each cycle during which the LED is “activated.” *Id.* Additionally, a reduced drive current means that the amount of current used to activate the LED is reduced, leading to reduced activation of the LED. *Id.* Accordingly, the combination of Amano and Turcott teaches that continuously operating at the lower power consumption state includes reducing activation of an attached sensor by reducing the drive current or the duty cycle of the LED. *Id.*

#### **Limitation 1[g]**

*Supra*, Ground 3A, 9[a]-9[b]; APPLE-1003, ¶¶102-103.

#### **4. Claim 2**

*Supra*, Ground 3B, 1[f]; APPLE-1003, ¶¶122-124.

### 5. Claim 3

In the combination, Amano's pulse wave examination apparatus allows a subject to "detect his pulse condition continuously in his daily life." APPLE-1004, 36:23-27, 38:26-27; APPLE-1003, ¶125. As previously discussed (*supra* Ground 3A, 9[d]), Amano teaches comparing processing characteristics to a predetermined value to determine whether body movement is present in the waveform. APPLE-1004, 21:57-65, 34:3-15, 35:54-59; APPLE-1003, ¶106. When the apparatus of Amano is continuously operating in the higher power consumption state, the apparatus compares processing characteristics to a predetermined value to determine whether motion is present in the waveform. APPLE-1004, 21:57-65, 34:3-15, 35:54-59; APPLE-1003, ¶125.

Through Amano, the combination provides that "when... no body movement is present, the operations of the waveform treating section 21 and body movement component eliminating section 30 are suspended" and "the pulse waveform MH is output directly from the body movement component eliminating section 30." APPLE-1004, 21:65-22:4, 35:54-64. Amano teaches that suspending the operations of sections 21 and 30 when there is no body movement "reduce[s] power consumption in the apparatus." APPLE-1004, 21:50-22:6, 35:54-64; APPLE-1003, ¶126. Accordingly, Amano teaches that during operating at the higher power consumption level where the operations of sections 21 and 30 are

performed, the apparatus monitors when the processing characteristics recedes from the threshold, indicating that no body movement or motion is present, and when receded, transitioning to continuously operating the patient monitor at the lower power consumption level where the operations of sections 21 and 30 are suspended. APPLE-1003, ¶126; APPLE-1004, 21:57-22:4, 34:3-15, 35:54-59.

## **6. Claim 15**

### **Limitation 15[p]**

*Supra*, Ground 3A, 9[p]; APPLE-1003, ¶¶99-101.

### **Limitation 15[a]**

*Supra*, Ground 3A, 9[a]-9[b]; APPLE-1003, ¶¶102-103.

### **Limitation 15[b]**

*Supra*, Ground 3A, 20[b]; APPLE-1003, ¶¶104-105, 113.

### **Limitation 15[c]**

*Supra*, Ground 3A, 20[c]; APPLE-1003, ¶¶104-106, 113.

### **Limitation 15[d]**

*Supra*, Ground 3A, 20[d]; APPLE-1003, ¶¶107-108, 104-105, 113.

### **Limitation 15[e]**

*Supra*, Ground 3A, 20[b]; Ground 3B, 1[f]; APPLE-1003, ¶¶104-105, 113, 122-124.

**7. Claim 16**

*Supra*, Ground 3A, 20[b]; Ground 3B, 1[f]; APPLE-1003, ¶¶104-105, 113, 122-124.

**8. Claim 17**

*Supra*, Ground 3B, Claim 3; APPLE-1003, ¶¶125-126, 106.

**IV. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION**

Consistent with Congressional intent and goals of *NHK/Fintiv*,<sup>5</sup> Apple asks the Board alone to consider challenges raised in this Petition. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11, 6 (PTAB 2020). As explained below, *Fintiv* favors institution.

**A. Factor 1: Institution will increase the likelihood of stay**

Institution will enable the Board to resolve the issue of validity, and a

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<sup>5</sup> The *NHK-Fintiv* rule should not be applied because it violates the AIA, which allows IPR to proceed in tandem with infringement litigation so long as the petition is filed within one year of service of a complaint of infringement. *See* 35 U.S.C. § 315(b). The rule also is arbitrary and capricious because its vague factors lead to speculative, unpredictable, and unfair outcomes. Further, the rule is procedurally invalid because it was not adopted through notice-and-comment rulemaking.

finding of invalidity will relieve the Central District of California (the “District Court”) of the need to continue with the companion litigation. Apple intends to move to stay the District Court case, and the opportunity for such simplification increases the likelihood that the court will grant a stay in view of IPR institution.

*Uniloc USA, Inc. v. Samsung Elecs. Am., Inc.*, Case No. 2:16-cv-642-JRG, 2-3 (E.D. Tex. 2017); *NFC Techs. LLC v. HTC Am., Inc.*, Case No. 13-CV-1058, 2015 WL 1069111 (E.D. Tex. 2015).

**B. Factor 2: District Court schedule**

Trial in the District Court case is scheduled for April 5, 2022. APPLE-1031,

1. Based on the 18-month IPR schedule, a Final Written Decision (“FWD”) in an IPR arising from the present Petition would issue in early March of 2022, prior to the District Court trial date.

In addition, as in *NHK*, district court trial dates shift, even in normal times. *Mylan Pharma. Inc. v. Sanofi-Aventis Deutschland GMBH*, IPR2018-01680, Pap. 22, 17 (PTAB 2019). The District Court is one of the country’s busiest patent courts, and the trial date of another case in the District Court has recently been postponed by approximately ten months. APPLE-1036, 2. Scheduling issues cannot be ruled out, as experts have professed that additional COVID-19 outbreaks are likely to arise and California is facing new outbreaks. APPLE-1034, 1 (“Fauci says second wave of coronavirus is ‘inevitable’”); APPLE-1035, 4 (“Los Angeles

County is currently” at “275 [cases] per 100,000 [residents],” which is higher than the recommended level (100 per 100,000) for reopening).

**C. Factor 3: Apple’s investment in IPR outweighs forced investment in litigation to date**

District court proceedings are still at an early phase. The parties have yet to file claim construction briefs, no claim construction orders have issued, and the *Markman* hearing is not scheduled until February 8, 2021. APPLE-1031, 1. In addition, discovery is not scheduled to close until July 5, 2021. *Id.*

Apple’s substantial investment in these IPR proceedings should counterbalance—if not outweigh—the resources invested in the co-pending litigation given the speed with which Apple is filing IPR petitions on over 150 claims across seven patents. It would be unjust to consider resources expended in District Court (equally by both parties), without considering Apple resources expended to prepare nine IPR petitions that would be irretrievably lost without consideration on the merits, in addition to the extensive expenses that may be foregone through institution of Apple’s petitions and that will otherwise certainly follow in co-pending litigation for which significant milestones exist. *See, e.g., Apple v. Seven Networks*, IPR2020-00255, Paper 13 at 12-15 (PTAB July 28, 2020) (declining to exercise 314(a) discretion on petitions filed 9 months after the commencement of co-pending litigation where a large number of patents were

included in the litigation, and a large number of claims from each patent were challenged in the petitions).

**D. Factor 4: The Petition raises unique issues**

Consistent with *Fintiv*, Apple asks the Board to consider the unique challenges raised in the Petition. Apple has voluntarily stipulated to counsel for Patent Owner that, if the Board institutes the present Petition, Apple will not assert that the challenged claims are invalid on the pending Petition's asserted grounds in *Masimo Corporation et al. v. Apple Inc.*, Case No. 8:20-cv-00048 (C.D. Cal.). APPLE-1032, 1; *see, e.g., Apple v. Seven* at 15-17 (finding that such a stipulation by a petitioner "mitigates, at least to some degree, the concerns of duplicative efforts between the district court and the Board, as well as concerns of potentially conflicting decisions").

In addition, the Petition addresses claims that will not be addressed in District Court. Although Patent Owner has not yet narrowed the asserted claims, the District Court recently ordered the parties to submit "a joint proposal for an initial reduction of infringement contentions" by September 21, 2020. APPLE-1033, 1. Thus, based on this ordered reduction in the asserted claims, the District Court will necessarily address fewer claims than are challenged in this Petition (which challenges all claims of the patent), even assuming the District Court addresses validity at all, which is presently unknowable. *See, e.g., Apple v. Seven*

at 18.

In short, grounds in this Petition are unique, and will not be addressed in District Court. *See, e.g., Apple v. Seven* at 15-20 (weighing this factor against exercising 314(a) discretion where a petitioner challenged several unasserted claims and stipulated that it would not pursue the IPR grounds in the co-pending litigation).

**E. Factor 5: Institution would provide the Board an opportunity to invalidate claims that could later be reasserted against others**

Apple's Petition is potentially helpful to future defendants. For at least this reason, Apple's status as both Petitioner and defendant is, at worst, a neutral factor. Taking the relevant circumstances into account, institution would serve overall efficiency and integrity, enabling the Board to determine invalidity of claims that Patent Owner might otherwise later assert against others.

**F. Factor 6: Other circumstances support institution**

As *Fintiv* noted, "the factors ... are part of a balanced assessment of all the relevant circumstances in the case," and, "if the merits of a ground raised in the petition seem particularly strong ... the institution of a trial may serve the interest of overall system efficiency and integrity ...." *Fintiv*, 14-15. As explained in the Petition (and Dr. Anthony's testimony), institution would result in invalidation of the Challenged Claims.



## **V. PAYMENT OF FEES**

Apple authorizes the Patent and Trademark Office to charge Deposit Account No. 06-1050 for the fee set in 37 C.F.R. § 42.15(a) for this Petition and further authorizes payment for any additional fees to be charged to this Deposit Account.

## **VI. CONCLUSION**

Apple respectfully requests institution of an IPR for the Challenged Claims.

## **VII. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)**

### **A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)**

Petitioner, Apple Inc., is the real party-in-interest.

### **B. Related Matters Under 37 C.F.R. § 42.8(b)(2)**

Apple is not aware of any disclaimers, reexamination certificates, or petitions for *Inter Partes* Review for the '703 Patent. The '703 patent is the subject of the civil action *Masimo Corporation et al. v. Apple Inc.*, Case No. 8:20-cv-00048 (C.D. Cal.).

The '703 Patent is in the same family as U.S. Patent No. 10,433,776 ("the '776 Patent"). Apple has petitioned for *Inter Partes* Review of the '776 Patent.

U.S. Patent Application No. 15/820,082 filed on November 21, 2017 and U.S. Patent Application No. 16/174,130 filed on October 29, 2018 claim the

benefit of the '703 Patent and are currently pending before the Patent Office.

**C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)**

Apple provides the following designation of counsel.

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**D. Service Information**

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at [IPR50095-0002IP1@fr.com](mailto:IPR50095-0002IP1@fr.com)

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Respectfully submitted,

Dated: September 9, 2020

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IPR of U.S. Patent No. 8,457,703

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(Control No. IPR2020-01523)

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**CERTIFICATION UNDER 37 CFR § 42.24**

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter partes* Review totals 13,956 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: September 9, 2020

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**CERTIFICATE OF SERVICE**

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on September 9, 2020, a complete and entire copy of this Petition for *Inter partes* Review and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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