

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE INC.,
Petitioner,

v.

ALIVECOR, INC.,
Patent Owner.

IPR2021-00971
Patent 10,595,731

**PETITIONER'S REPLY TO
PATENT OWNER'S PRELIMINARY RESPONSE**

EXHIBIT LIST

- APPLE-1001 U.S. Pat. No. 10,595,731 to Gopalakrishnan (“the ’731 patent”)
- APPLE-1002 Excerpts from the Prosecution History of the ’731 patent (“the Prosecution History”)
- APPLE-1003 Declaration of Dr. Bernard A. Chaitman
- APPLE-1004 PCT Patent Publication WO2012/140559 (“Shmueli”)
- APPLE-1005 U.S. Patent Publication 2014/0275840 (“Osorio”)
- APPLE-1006 Li Q, Clifford GD, “Signal quality and data fusion for false alarm reduction in the intensive care unit,” J Electrocardiol. 2012 Nov-Dec; 45(6):596-603 (“Li-2012”)
- APPLE-1007 U.S. Patent Publication 2008/0004904 (“Tran”)
- APPLE-1008 U.S. Patent Publication 2014/0107493 (“Yuen”)
- APPLE-1009 U.S. Patent Publication 2015/0119725 (“Martin”)
- APPLE-1010 U.S. Provisional Application No. 61/794,540 (“OP”)
- APPLE-1011 Lee J, Reyes BA, McManus DD, Mathias O, Chon KH. Atrial fibrillation detection using a smart phone. International Journal of Bioelectromagnetism, Vol. 15, No. 1, pp. 26 - 29, 2013 (“Lee 2013”)
- APPLE-1012 Tsipouras MG, Fotiadis DI. Automatic arrhythmia detection based on time and time-frequency analysis of heart rate variability. Comput Methods Programs Biomed. 2004 May; 74(2):95-108 (“Tsipouras 2004”)
- APPLE-1013 Lu S, Zhao H, Ju K, Shin K, Lee M, Shelley K, Chon KH. Can photoplethysmography variability serve as an alternative approach to obtain heart rate variability information? J Clin

Monit Comput. 2008 Feb; 22(1):23-9 (“Lu 2008”)

- APPLE-1014 Selvaraj N, Jaryal A, Santhosh J, Deepak KK, Anand S. Assessment of heart rate variability derived from finger-tip photoplethysmography as compared to electrocardiography. J Med Eng Technol. 2008 Nov-Dec; 32(6):479-84 (“Selvaraj 2008”)
- APPLE-1015 Lu G, Yang F, Taylor JA, Stein JF. A comparison of photoplethysmography and ECG recording to analyse heart rate variability in healthy subjects. J Med Eng Technol. 2009; 33(8):634-41 (“Lu 2009”)
- APPLE-1016 Suzuki T, Kameyama K, Tamura T. Development of the irregular pulse detection method in daily life using wearable photoplethysmographic sensor. Annu Int Conf IEEE Eng Med Biol Soc. 2009; 2009:6080-3 (“Suzuki 2009”)
- APPLE-1017 Reed MJ, Robertson CE, Addison PS. Heart rate variability measurements and the prediction of ventricular arrhythmias. QJM. 2005 Feb; 98(2):87-95 (“Reed 2005”)
- APPLE-1018 Schäfer A, Vagedes J. How accurate is pulse rate variability as an estimate of heart rate variability? A review on studies comparing photoplethysmographic technology with an electrocardiogram. Int J Cardiol. 2013 Jun 5; 166(1):15-29 (“Schafer 2013”)
- APPLE-1019 K. Douglas Wilkinson, “The Clinical Use of the Sphygmomanometer,” The British Medical Journal, 1189-90 (Dec. 27, 1924) (“Wilkinson”)
- APPLE-1020 U.S. Pat. No. 6,095,984 (“Amano”)
- APPLE-1021 B.K. Bootsma et. al, “Analysis of R-R intervals in patients with atrial fibrillation at rest and during exercise.” Circulation 1970; 41:783-794
- APPLE-1022 Frits L. Meijler and Fred H. M. Wittkamp, “Role of the

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Atrioventricular Node in Atrial Fibrillation” Atrial Fibrillation: Mechanisms and Management, 2nd ed. 1997 (“Meijler”)

- APPLE-1023 Heart Diseases _ Definition of Heart Diseases by Merriam-Webster
- APPLE-1024 Acharya UR, Joseph KP, Kannathal N, Lim CM, Suri JS. Heart rate variability: a review. Med Biol Eng Comput. 2006 Dec; 44(12):1031-51 (“Acharya 2006”)
- APPLE-1025 Saime Akdemir Akar, Sadık Kara, Fatma Latifoğlu, Vedat Bilgiç. Spectral analysis of photoplethysmographic signals: The importance of preprocessing. Biomedical Signal Processing and Control, 2013; 8(1):16-22 (Akar 2013)
- APPLE-1026 U.S. Provisional Application No. 61/915,113
- APPLE-1027 U.S. Provisional Application No. 61/953,616
- APPLE-1028 U.S. Provisional Application No. 61/969,019
- APPLE-1029 U.S. Provisional Application No. 61/970,551
- APPLE-1030 U.S. Provisional Application No. 62/014516
- APPLE-1031 U.S. Patent Publication No. 2012/0203491 (“Sun”)
- APPLE-1032 U.S. Patent No. 9,808,206 (“Zhao”)
- APPLE-1033 Kleiger RE, Stein PK, Bigger JT Jr. Heart rate variability: measurement and clinical utility. Ann Noninvasive Electrocardiol. 2005 Jan; 10(1):88-101 (“Kleiger-2005”)
- APPLE-1034 Chen Z, Brown EN, Barbieri R. Characterizing nonlinear heartbeat dynamics within a point process framework. IEEE Trans Biomed Eng. 2010 Jun; 57(6):1335-47 (“Chen 2010”)
- APPLE-1035 Karvonen, J., Vuorimaa, T. Heart Rate and Exercise Intensity

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 (“Karvonen 1988”)

- APPLE-1036 Yu C, Liu Z, McKenna T, Reisner AT, Reifman J. A method for automatic identification of reliable heart rates calculated from ECG and PPG waveforms. J Am Med Inform Assoc. 2006 May-Jun; 13(3):309-20 (“Yu 2006”)
- APPLE-1037 AliveCor v Apple ITC Complaint Exhibit 11 (731 Infringement Chart)
- APPLE-1038 Tavassoli, M, Ebadzadeh, MM, Malek H. (2012). Classification of cardiac arrhythmia with respect to ECG and HRV signal by genetic programming. Canadian Journal on Artificial Intelligence, Machine Learning and Pattern Recognition. 3. 1-13 (“TavassoLi-2012”)
- APPLE-1039 Asl BM, Setarehdan SK, Mohebbi M. Support vector machine-based arrhythmia classification using reduced features of heart rate variability signal. Artif Intell Med. 2008 Sep; 44(1):51-64 (“Asl 2008”)
- APPLE-1040 Yaghouby F., Ayatollahi A. (2009) An Arrhythmia Classification Method Based on Selected Features of Heart Rate Variability Signal and Support Vector Machine-Based Classifier. In: Dössel O., Schlegel W.C. (eds) World Congress on Medical Physics and Biomedical Engineering, September 7 - 12, 2009, Munich, Germany. IFMBE Proceedings, vol 25/4. Springer, Berlin, Heidelberg (“Yaghouby 2009”)
- APPLE-1041 Dallali, A, Kachouri, A, Samet, M. (2011). Integration of HRV, WT and neural networks for ECG arrhythmias classification. ARPN Journal of Engineering and Applied Sciences. VOL. 6. 74-82 (“Dallali 2011”)
- APPLE-1042 Sajda P. Machine learning for detection and diagnosis of disease. Annu Rev Biomed Eng. 2006; 8:537-65 (“Sajda 2006”)

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