UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

THE RESEARCH FOUNDATION FOR THE STATE UNIVERSITY OF NEW YORK and UNIVERSITY OF CONNECTICUT and WORCESTER POLYTECHNIC INSTITUTE, Plaintiffs, v. SAMSUNG ELECTRONICS CO., LTD.; SAMSUNG ELECTRONICS AMERICA, INC.; SAMSUNG AUSTIN SEMICONDUCTOR, LLC; SAMSUNG SEMICONDUCTOR, INC., Defendants.	Case No. 2:23-cv-00141 Jury Trial Demanded

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiffs The Research Foundation for The State University of New York, University of Connecticut, and Worcester Polytechnic Institute (collectively, "Plaintiffs" and/or "the Universities"), by and through their counsel, file this Complaint against Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., Samsung Austin Semiconductor, LLC, and Samsung Semiconductor, Inc. (collectively, "Defendants" and/or "Samsung") for infringement of United States patent nos. 8,417,326 ("the '326 patent"), 8,718,753 ("the '753 patent"), 9,408,576 ("the '576 patent"), 9,713,428 ("the '428 patent"), 9,872,652 ("the '652 patent"), 9,986,921 ("the '921 patent"), 10,278,647 ("the '647 patent"), 10,285,601 ("the '601 patent"), and 10,653,362 ("the '362 patent") (collectively, the "patents-in-suit"), and allege as follows:

NATURE OF THE ACTION

1. This is an action for infringement of the patents-in-suit arising under the patent laws of the United States, 35 U.S.C. §§ 100, *et seq.* Specifically, this action relates to patents directed to the monitoring and/or detection of smartwatch wearers' physiological functions.

PARTIES

2. Plaintiff The Research Foundation for The State University of New York (the "Research Foundation") is a non-profit educational corporation duly organized and existing under the laws of the State of New York, having a principal place of business at 35 State Street, Albany, New York 12207.

3. Plaintiff University of Connecticut ("UConn") is a constituent unit of the State of Connecticut, having a business address at 352 Mansfield Road, Storrs, Connecticut 06269.

4. Plaintiff Worcester Polytechnic Institute ("WPI") is a charitable corporation organized and existing under the laws of Massachusetts, having a principal place of business at 100 Institution Road, Worchester, Massachusetts 01609.

5. On information and belief, Defendant Samsung Electronics Co., Ltd. ("SEC") is a company organized and existing under the laws of the Republic of Korea, having a principal place of business at 129 Samsung-Ro, Maetan-3dong, Yeongtong-Gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea.

6. On information and belief, Defendant Samsung Electronics America, Inc. ("SEA") is a corporation organized and existing under the laws of New York, having a

principal place of business at 85 Challenger Road, Ridgefield Park, New Jersey 07660. On information and belief, SEA is a wholly-owned subsidiary of SEC. On information and belief, SEA has business locations in this Judicial District at 6625 Excellence Way, Plano, Texas 75023; 2601 Preston Road, Frisco, Texas 75034; and 3580 Preston Road, Suite 100, Frisco, Texas 75034. On information and belief, SEA may be served in Texas via its registered agent, CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

7. On information and belief, Samsung Semiconductor, Inc. ("SSI") is a corporation organized and existing under the laws of California, having a principal place of business at 3655 North First Street, San Jose, California 95134. On information and belief, SSI is a wholly-owned subsidiary of and is controlled and directed by, SEA, which as noted above, has business locations in this Judicial District. On information and belief, Defendant SSI has a research center and manufacturing facility located at 3900 San Clemente, Suite 300, North Capital of Texas Highway, Austin, Texas 78746, and maintains facilities at 6625 Excellence Way, Plano, Texas 75023. On information and belief, SSI may be served in Texas via its registered agent, National Registered Agents, Inc., 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

8. On information and belief, Defendant Samsung Austin Semiconductor, LLC ("SAS") is a corporation organized and existing under the laws of Delaware, having a principal place of business at 12100 Samsung Blvd., Austin, Texas 78754. On information and belief, SAS is a wholly-owned subsidiary of SSI. SAS may be served in

Texas via its registered agent, CT Corporation System, 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

9. SEC, SEA, SSI, and SAS are referred to collectively hereinafter as "Defendants" or "Samsung."

10. On information and belief, Defendants are engaged in making, using, offering for sale, selling, importing, or otherwise providing, within the United States and this Judicial District, directly or indirectly, physiological monitoring devices utilizing protected corresponding algorithms and/or related products and services, with features and functionalities that infringe the patents-in-suit.

JURISDICTION AND VENUE

11. This Court has subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a) because this action arises under the patent laws of the United States, 35 U.S.C. § 1 *et seq*., including 35 U.S.C. § 271.

12. Each Defendant is subject to this Court's personal jurisdiction consistent with the principles of due process and the Texas Long Arm Statute. Tex. Civ. Prac. & Rem. Code §§ 17.041, *et seq*.

13. Jurisdiction and venue for this action are proper in this Judicial District.

14. This Court has personal jurisdiction over Defendants at least because, through each and/or all of a respective Defendant's own acts and/or through the acts of each other Defendant acting as its agent, representative, or alter ego, they each (i) have a presence and/or a regular and established place of business in the State of Texas and this Judicial District; (ii) have purposefully availed themselves of the rights and

benefits of the laws of the State of Texas and this Judicial District; (iii) have done and are doing substantial business in the State of Texas and this Judicial District, directly or through intermediaries, both generally and, on information and belief, with respect to the allegations in this Complaint, including their one or more acts of infringement in the State of Texas and this Judicial District; (iv) maintain continuous and systematic contacts in the State of Texas and this Judicial District; and/or (v) place products alleged to be infringing in this Complaint in the stream of commerce, directly or through intermediaries, with awareness that those products are likely destined for use, offered for sale, sold, and/or imported, in the State of Texas and this Judicial District.

15. For example, Defendants have authorized retailers and distributors in the State of Texas and this Judicial District for the products alleged to be infringing in this Complaint, and Defendants have derived substantial revenues from their infringing acts occurring within the State of Texas and this Judicial District.

16. Defendants have established sufficient minimum contacts with the State of Texas and this Judicial District such that they should reasonably and fairly anticipate being brought into court in the State of Texas and this Judicial District without offending traditional notions of fair play and substantial justice, and Defendants have purposefully directed activities at residents of the State of Texas and this Judicial District. Moreover, the patent infringement claims alleged herein arise out of or are related to one or more of the foregoing activities. On information and belief, a

substantial part of the events giving rise to Plaintiffs' claims, including acts of patent infringement, have occurred in the State of Texas and this Judicial District.

17. Venue is proper in this Court under 28 U.S.C. §§ 1391 and 1400(b) because each Defendant is subject to personal jurisdiction in this Judicial District and has committed acts of infringement in this Judicial District. Each Defendant, through its own acts and/or through the acts of each other Defendant acting as its agent, representative, or alter ego, makes, uses, sells, offers to sell, and/or imports infringing products within this Judicial District, has a continuing presence within this Judicial District, and has the requisite minimum contacts with this Judicial District such that venue is proper.

18. For example, on information and belief, SEA maintains a regular and established place of business in this Judicial District at 6625 Excellence Way, Plano, Texas 75023 and has committed acts of infringement in this District. Further, on information and belief, SEC directs and controls the actions of SEA such that it too maintains a regular and established place of business in this Judicial District at 6625 Excellence Way, Plano, Texas 75023 and has committed acts of infringement in this District.

19. Additionally, venue is proper as to SEC, a foreign corporation, because suits against foreign entities are proper in any judicial district under 28 U.S.C. § 1391(c)(3).

20. Defendants have not contested venue or the exercise of personal jurisdiction in this District for previously filed patent infringement actions by other parties. *See, e.g.*, Answer, ¶¶ 13, 18, *Cal. Inst. Tech v. Samsung Elecs. Co.,* No. 2:21-cv-00446 (E.D. Tex. Apr. 5, 2022), ECF No. 19; Answer to Amended Complaint, ¶¶ 6, 7, *Jawbone Innovations LLC v. Samsung Elecs. Co.,* No. 2:21-cv-00186 (E.D. Tex. Dec. 9, 2021), ECF No. 27.

JOINDER

21. Plaintiff incorporates each of the preceding paragraphs as if fully set forth here.

22. Joinder is proper under at least Fed. R. Civ. P. 20 and 35 U.S.C. § 299 at least because Defendants' infringing conduct alleged herein arises out of the same transaction, occurrence, or series of transactions or occurrences relating to the making, using, importing into the United States, offering for sale, or selling of the same accused product or process, or portions thereof, and questions of fact common to all Defendants will arise in this action.

23. On information and belief, Samsung makes, uses, imports, offers for sale, and/or sells accused products. On information and belief, Samsung infringes the patents-in-suit by, for example, making, using, importing, offering for sale, and selling products incorporating the Plaintiffs' patents-in-suit. Thus, on information and belief, the common patents-in-suit are a defining characteristic for Samsung's infringement, and the factual question of infringement will thus substantially overlap for Samsung.

BACKGROUND

The Patents-in-Suit

24. Since their introduction to the mass-consumer market, smartwatch usage has grown tremendously. By the end of 2021, more than 200 million people were smartwatch users and the revenue generated by such devices is nearly $40 billion, with growth expected to continue rising in upcoming years.[1]

25. A primary reason for owning and wearing smartwatches is the ability to obtain physiological information and health parameters from the watch. For example, at least one study showed that 42% of smartwatch users have discussed such health information with their doctors, and 92% of smartwatch users reported that they use smartwatches to maintain and manage their health.[2]

26. To compete in this growing market, companies such as Samsung have worked to ensure that their products offer the cutting edge health-related features their consumers' desire.

Dr. Chon's Research

27. From 2002 through 2010, Dr. Ki Chon worked as a faculty member at The State University of New York at Stony Brook ("Stony Brook University") in the Department of Biomedical Engineering. During his time at Stony Brook University, Dr. Chon, along with members of his research team, developed and co-invented, *inter alia*,

[1] https://www.statista.com/forecasts/1314339/worldwide-users-of-smartwatches
[2] https://www.valuepenguin.com/fitness-tracker-smartwatch-health-survey

algorithms and devices for the detection of physiological functions. Pursuant to The State University of New York ("SUNY") patent policy, these patents are owned or co-owned by the Research Foundation.

28. From 2010 through 2014, Dr. Chon was a professor and, subsequently, the Department Head of Biomedical Engineering at WPI. During his time as a faculty member at WPI, Dr. Chon worked with members of his research team to develop and co-invent a multitude of algorithms and systems for the detection of physiological functions. These patents are owned and co-owned by WPI.

29. Dr. Chon is currently a professor of biomedical engineering at UConn with previous appointments at SUNY and WPI.

30. Dr. Chon's and his team's research produced technology that could detect atrial fibrillation, atrial flutter, and atrial tachycardia in real time. Among other things, Dr. Chon and his team were exploring whether the technology could be brought to the mass-consumer market through new devices and sensors such as smartwatches, mobile phones, and even clothing.

31. After many years of work at Stony Brook University, WPI, and UConn, and with the help of public funding, the Universities filed for and obtained patents to protect Dr. Chon's and his team's proprietary developments.

32. The Universities now commence this patent infringement action on the patents-in-suit to address Samsung's infringement, to recognize Dr. Chon and his co-

inventors' hard work and achievements, and to deter the future theft of publicly funded academic work for corporate profit.

United States Patent No. 8,417,326

33. U.S. Patent No. 8,417,326, entitled "RR Interval Monitoring Method and Blood Pressure Cuff Utilizing Same," (attached as Exhibit 1), was duly and legally issued on April 9, 2013.

34. The '326 patent will expire on August 4, 2028.

35. The inventors named on the '326 patent are Ki H. Chon and Ernst A. Raeder.

36. The '326 patent is directed to an apparatus and method for ambulatory, real-time detection of Atrial Fibrillation (AF) providing an overall accuracy that refers to the detection of AF, irrespective of the duration of AF and beat-to-beat classification.

37. The claims of the '326 patent are valid, enforceable, and not expired.

38. The '326 patent ultimately claims priority to U.S. Provisional Patent Application No. 60/953,508, filed on August 2, 2007, and U.S. Provisional Patent Application No. 61/084,389, filed on July 29, 2008.

39. All rights, title, and interest, including the right to sue for past infringement in the '326 patent are owned by and assigned to The Research Foundation for The State University of New York.

United States Patent No. 8,718,753

40. U.S. Patent No. 8,718,753, entitled "Motion and Noise Artifact Detection for ECG Data," (attached as Exhibit 2), was duly and legally issued on May 6, 2014.

41. The '753 patent will expire on October 12, 2031.

42. The inventors named on the '753 patent are Ki H. Chon and Jinseok Lee.

43. The '753 patent is directed to real-time detection of motion and noise (MN) artifacts in electrocardiogram signals recorded by electrocardiography devices. Specifically, the patent provides techniques for increasing the accuracy of identifying paroxysmal atrial fibrillation (AF) rhythms, which are often measured via such devices.

44. The claims of the '753 patent are valid, enforceable, and not expired.

45. The '753 patent ultimately claims priority to U.S. Provisional Patent Application No. 61/392,261, filed on October 12, 2010, and U.S. Provisional Patent Application No. 61/436,408, filed on January 26, 2011.

46. All rights, title, and interest, including the right to sue for past infringement in the '753 patent are owned by and assigned to Worcester Polytechnic Institute.

United States Patent No. 9,408,576

47. U.S. Patent No. 9,408,576, entitled "Detection and Monitoring of Atrial Fibrillation," (attached as Exhibit 3), was duly and legally issued on August 9, 2016.

48. The '576 patent will expire on May 12, 2034.

49. The inventors named on the '576 patent are Ki. H. Chon and Jowoon Chong.

50. The '576 patent is directed to an enhanced real-time realizable AF algorithm for the accurate detection of, and discrimination between, NSR, AF, PVC, and PAC.

51. The ’576 patent ultimately claims priority to U.S. Provisional Patent Application No. 61/818,207, filed on May 1, 2013.

52. All rights, title, and interest, including the right to sue for past infringement in the ’576 patent are owned by and assigned to Worcester Polytechnic Institute.

United States Patent No. 9,713,428

53. U.S. Patent No. 9,713,428, entitled “Physiological Parameter Monitoring with a Mobile Communication Device,” (attached as Exhibit 4), was duly and legally issued on July 25, 2017.

54. The ‘428 patent will expire on April 23, 2032.

55. The inventors named on the ’428 patent are Ki. H. Chon, Jinseok Lee and Nandakumar Selvaraj.

56. The ’428 patent is directed to systems and methods that enable physiological health monitoring with a mobile communication device and further allows the detection of motion artifacts in a manner such that results reported are of acceptable quality.

57. The ’428 patent ultimately claims priority to U.S. Provisional Patent Application No. 61/434,862, filed on January 21, 2011, U.S. Provisional Patent Application No. 61/512,199, filed on July 27, 2011, U.S. Provisional Patent Application No. 61/434,856, filed on January 21, 2011, and U.S. Provisional Patent Application No. 61/566,329, filed on December 2, 2011.

58. All rights, title, and interest, including the right to sue for past infringement in the '428 patent are co-owned by Worcester Polytechnic Institute and the Research Foundation for The State University of New York and assigned to Worcester Polytechnic Institute.

United States Patent No. 9,872,652

59. U.S. Patent No. 9,872,652, entitled "Method and Apparatus for Heart Rate Monitoring Using an Electrocardiogram Sensor," (attached as Exhibit 5), was duly and legally issued on January 23, 2018.

60. The '652 patent will expire on June 9, 2036.

61. The inventors named on the '652 patent are Ki. H. Chon, Seyed M. A. Salehizadeh and Yeonsik Noh.

62. The '652 patent is directed to a method and corresponding apparatus which employs a time-varying spectral analysis approach for reconstructing an electrocardiogram (ECG) signal that includes motion artifacts.

63. The '652 patent ultimately claims priority to U.S. Provisional Patent Application No. 62/299,944, filed on February 25, 2016, and U.S. Provisional Patent Application No. 62/172,862, filed on June 9, 2015.

64. All rights, title, and interest, including the right to sue for past infringement in the '652 patent are owned by and assigned to the University of Connecticut.

United States Patent No. 9,986,921

65. U.S. Patent No. 9,986,921, entitled "Detection and Monitoring of Atrial Fibrillation," (attached as Exhibit 6), was duly and legally issued on June 5, 2018.

66. The '921 patent will expire on May 1, 2035.

67. The inventors named on the '921 patent are Ki. H. Chon and Jowoon Chong.

68. The '921 patent is directed to a real-time arrhythmia discrimination method for use in smartphones, which can discriminate between NSR, AF, PACs, and PVCs by utilizing pulsatile time series collected from a smartphone's camera.

69. The '921 patent ultimately claims priority to U.S. Provisional Patent Application No. 61/987,057, filed on May 1, 2014.

70. All rights, title, and interest, including the right to sue for past infringement in the '921 patent are owned by and assigned to Worcester Polytechnic Institute.

United States Patent No. 10,278,647

71. U.S. Patent No. 10,278,647, entitled "Method and Apparatus for Removing Motion Artifacts from Biomedical Signals," (attached as Exhibit 7), was duly and legally issued on May 7, 2019.

72. The '647 patent will expire on January 24, 2037.

73. The inventors named on the '647 patent are Ki. H. Chon, Seyed M. A. Salehizadeh, and Yeonsik Noh.

74. The ’647 patent is directed to a method and corresponding apparatus employing a time-varying spectral analysis approach for reconstructing a heart-related signal that includes motion artifacts.

75. The ’647 patent ultimately claims priority to U.S. Provisional Patent Application No. 62/299,944, filed on February 25, 2016, and U.S. Provisional Patent Application No. 62/172,862, filed on June 9, 2015.

76. All rights, title, and interest, including the right to sue for past infringement in the ’647 patent are owned by and assigned to the University of Connecticut.

United States Patent No. 10,285,601

77. U.S. Patent No. 10,285,601, entitled “Detection and Monitoring of Atrial Fibrillation,” (attached as Exhibit 8), was duly and legally issued on May 14, 2019.

78. The ‘601 patent will expire on May 1, 2035.

79. The inventors named on the ’601 patent are Ki. H. Chon and Jowoon Chong.

80. The ’601 patent is directed to a real-time arrhythmia discrimination method for use in smartphones, which can discriminate between NSR, AF, PACs, and PVCs using pulsatile time series collected from a smartphone's camera.

81. The ’601 patent ultimately claims priority to U.S. Provisional Patent Application No. 61/987,057, filed on May 1, 2014.

82. All rights, title, and interest, including the right to sue for past infringement in the '601 patent are owned by and assigned to Worcester Polytechnic Institute.

United States Patent No. 10,653,362

83. U.S. Patent No. 10,653,362, entitled "Motion and Noise Artifact Detection and Reconstruction Algorithms for Photoplethysmogram and Equivalent Signals," (attached as Exhibit 9), was duly and legally issued on May 19, 2020.

84. The '362 patent will expire on November 28, 2037.

85. The inventors named on the '362 patent are Ki. H. Chon, Jo Woon Chong, Duy Dao, and Hamed Salehizadeh.

86. The '362 patent is directed to a pulse oximeter embedded with a motion and noise artifact (MNA) detection algorithm based on extraction of time-varying spectral features that are unique to the clean and corrupted components.

87. The '362 patent ultimately claims priority to U.S. Provisional Patent Application No. 62/109,183, filed on January 29, 2015.

88. All rights, title, and interest, including the right to sue for past infringement in the '362 patent are owned by and assigned to Worcester Polytechnic Institute.

Samsung Watches

89. On information and belief, Defendants sell multiple models and/or versions of the Samsung Galaxy watch. *See*

https://ss7.vzw.com/is/content/VerizonWireless/samsung-noblesse-galaxy-watch3-ug attached as Exhibit 10.

90. As stated on Samsung's website, "The Galaxy Watch is a smartwatch that can analyze your exercise pattern, manage your health and allows you to use a variety of convenient apps for making phone calls and playing music." *Id.*

91. Samsung's website also lists, generally, the Samsung Galaxy watches' main features, noting their ability to be a "personal health coach." *Id.*

92. The personal health coach features include at least the following: "39 kinds of indoor and outdoor exercise and tracks your progress in detail… Track[ing] exercise time, calories burned, heart rate, distance, speed, and pace….. measure[ing] your heart rate more precisely… More accurate heart rate measurement[s] with four photodiode sensors… Checks for continuous motion to monitor sleep phases and improve sleep quality… Checks stress levels & breathing…. Monitor[s] your health stats via Samsung Health." *Id.*

93. The Samsung Galaxy Watch3 LTE Model is shown in the image below. The image is featured in a Samsung user manual as an example of the various models and/or versions of the Samsung Galaxy watches that Samsung manufactures, uses, sells, offers to sell, and/or imports into the United States. *Id.*

Notice of the Patents-in-Suit and Willful Infringement

94. In June 2015, Dr. Ki Chon met with Matthew Wiggins, the Senior Algorithm Manager at Samsung Strategy and Innovation Center, during a conference in Boston.

95. Mr. Wiggins was a keynote speaker at the conference, discussing Samsung's "Simband."

96. Following the conference, Dr. Chon sent a follow-up email to Mr. Wiggins regarding the opportunity to work in conjunction with Samsung.

97. Dr. Chon's email highlighted his desire to use the Samsung "Simband" watches for AF data collection. At the time, Dr. Chon had received funding from the National Institute of Health ("NIH") to conduct a clinical study with his medical colleague at the University of Massachusetts in Worcester.

98. Samsung expressed interest in working with Dr. Chon and his team to develop additional AF functionality. Samsung sent approximately 20 Simbands to Dr. Chon for research purposes, including Dr. Chon using the watches to perform continuous AF data collection utilizing his proprietary algorithm.

99. Dr. Chon and Samsung worked together from 2016 to 2018. During that time period, all of Dr. Chon's AF data was available to Samsung.

100. Samsung was pleased with Dr. Chon's work. For example, in June 2018, Mr. Wiggins sent an email to Dr. Chon and his colleague stating in part that "I'm glad to hear you guys are continuing your research and have made some good progress broadening the applicability of the algorithm."

101. Dr. Chon told Samsung that he and his colleagues were also working on new algorithm development especially related to PPG signals, as well as ways to improve their AF detection including the peak detection algorithm in their lab. Dr. Chon also proposed a possible further collaborative development agreement.

102. Mr. Wiggins expressed excitement about Dr. Chon's advancements in the PPG AF detection technology and suggested entering a non-disclosure agreement to explore further steps, which the parties did, specifically related to evaluations of Dr. Chon's new AF peak detection algorithm data.

103. In August 2018, Dr. Chon's colleague went to California to meet with Samsung regarding progress made using the Simbands. Samsung was internally reviewing and negotiating taking the cardiac product to market, and the algorithms

from Dr. Chon's work were considered a core component. Samsung was also very interested in doing an evaluation of the new algorithm.

104. In fact, Dr. Chon's algorithm was in a clinical trial at Samsung.

105. After meeting in California in 2018, communication between Samsung and Dr. Chon ceased.

106. In September 2020, after being cleared by the FDA, Samsung released its Health Monitor app for use in both the Galaxy Watch3 and Galaxy Watch Active2, marking the first time any of Samsung's watches were capable of AF detection.

107. Prior to Samsung's release of its Health Monitor app, Samsung's employees informed Dr. Chon that they read and kept abreast of Dr. Chon's publications and articles.

108. On information and belief and without authorization, Samsung utilized Dr. Chon's data and findings, as well as his patented algorithms, to manufacture and sell various smartwatches, including the Galaxy watches described above, in the years to follow.

PATENT INFRINGEMENT

Count I: Infringement of United States Patent No. 8,417,326 by Samsung

109. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

110. On information and belief, Defendants' products, including at least the Samsung Galaxy Watch3, Galaxy Watch4, Galaxy Watch4 Classic, Galaxy Watch5,

Galaxy Watch5 Pro, and Galaxy Watch Active2, infringe at least Claim 1 of the '326 patent under 35 U.S.C. §271.

111. On information and belief, Defendants have directly infringed one or more claims of the '326 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Galaxy Watch3, Galaxy Watch4, Galaxy Watch4 Classic, Galaxy Watch5, Galaxy Watch5 Pro, and Galaxy Watch Active2 devices ("the Accused Watches").

112. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '326 patent, and the above-listed Samsung Watches may infringe additional patents.

113. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

114. For example, Claim 1 covers:

> An Atrial Fibrillation (AF) analysis method comprising:
> obtaining an output that includes a heart beat;
> deriving a heart beat interval;
> analyzing a number (N) of heart beat intervals from the output; and
> detecting a likelihood of AF by:
> calculating a Turning Points Ratio (TPR) of the N heart beat intervals;
> calculating a root mean square of successive (RMSSD) heart beat intervals;
> and calculating Shannon Entropy (SE) of the N heart beat intervals.

115. The algorithm used by the Accused Watches does AF analysis, including as shown below.

https://images.samsung.com/is/content/samsung/p5/in/apps/samsung-health-

monitor/ifu/pdf/IFU_ECG_IN_20210116.pdf,

https://developer.samsung.com/health/privileged,

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor.

7. Reviewing Your ECG Reports on Your Galaxy Phone

After you take an ECG, the ECG data is synced to the paired Galaxy phone where a PDF report is created.

1. Open the Samsung Health Monitor app on your Galaxy phone.
2. Tap the thumbnail to see your latest ECG report, or tap **View history** to see all the available reports.

You may get any of the four following results:

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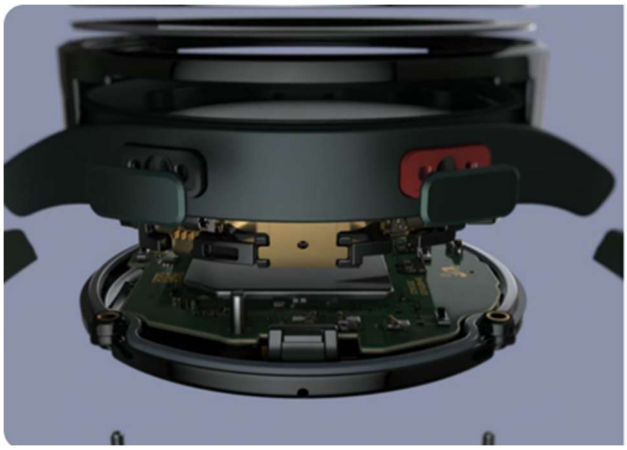
- **Sinus Rhythm**—This result means that during the recording the heart was beating in a regular rhythm with a heart rate of 50–100 beats per minute (BPM).
  - **Caution**: A Sinus Rhythm result does not guarantee that you are not experiencing an arrhythmia or other health condition. If you are not feeling well, contact your doctor.
- **Atrial Fibrillation (AFib)**—This result means that during the recording the heart was beating in an irregular rhythm with a heart rate of 50–120 BPM. If you get this result, contact your doctor for guidance.
- **Inconclusive**—This result means that the ECG recording could not be classified because the heart rate was either too high or too low, or the rhythm was not Atrial Fibrillation or Sinus Rhythm. If you get this result repeatedly, contact your doctor.

8. Safety and Performance

The clinical validation for ECG App tested its accuracy in detecting Sinus Rhythm and Atrial Fibrillation in ECG recordings for 544 subjects. The ECG App rhythm classifications were compared with rhythm classifications performed by a board-certified cardiologists using a 12-lead ECG. The ECG App had a sensitivity of 98.1% in detecting AFib and specificity of 100% in classifying sinus rhythm for all classifiable recordings.

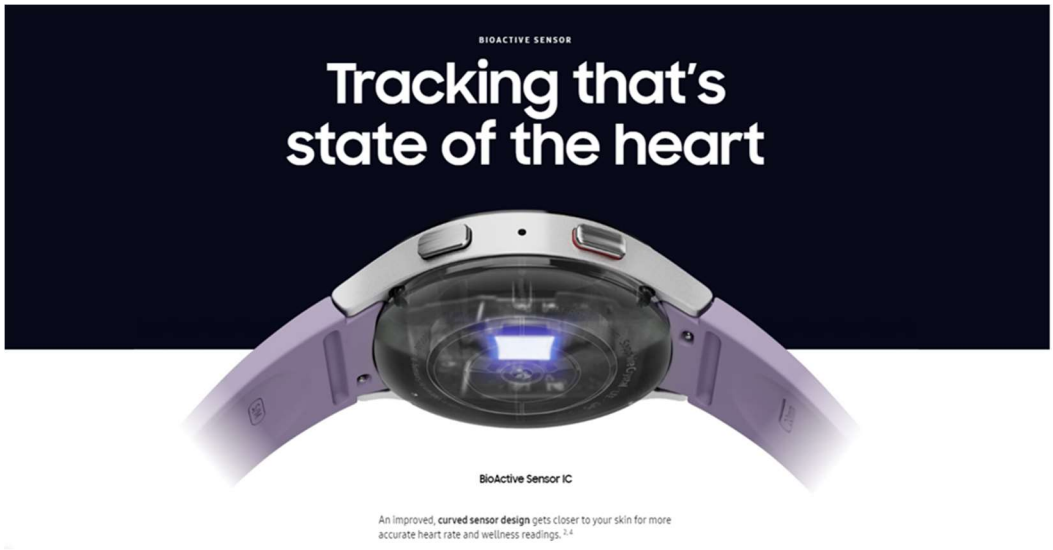
During clinical trials, 16.8% of ECG recordings were either inconclusive or poor recording. If all of these recordings are included, the sensitivity of the ECG App is 87.1% and specificity to detect sinus rhythm is 82.5%. Real-world performance may have more inconclusive and poor recordings.

The ECG PDF report was compared against a standard Lead 1 ECG for key intervals (PR, RR), QRS duration and amplitude. No adverse events were reported during this clinical trial.



Leveraging Galaxy Watch's Advanced...

As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...



BioActive Sensor IC

An improved, **curved sensor design** gets closer to your skin for more accurate heart rate and wellness readings. [2,4]

Optical Heart Rate Sensor

Monitor your heart rate during workouts and as you recover. With heart rate sensors and more, you can optimize your performance to reach new goals. [2]

116. The algorithm used by the Accused Watches obtains an output that includes a heart beat, including as shown below.

https://www.samsung.com/africa_en/support/mobile-devices/how-do-imeasure-the-ecg-on-galaxy-watch-device/.

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

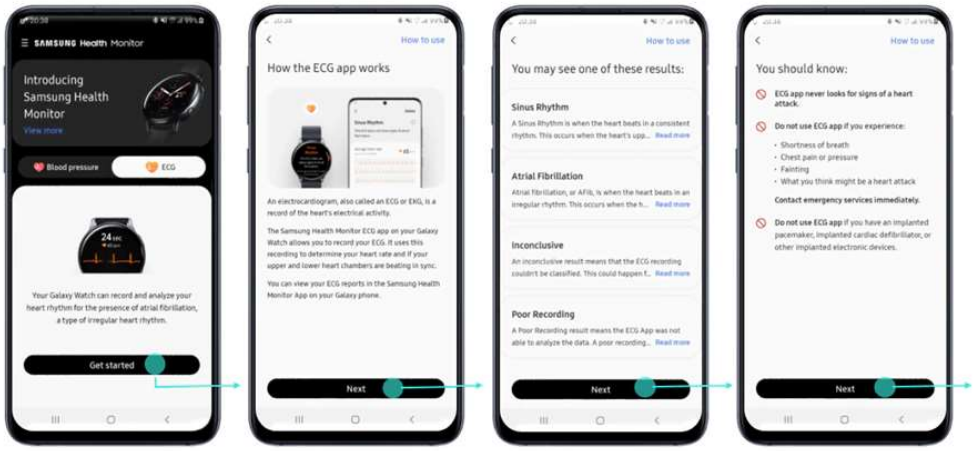
A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

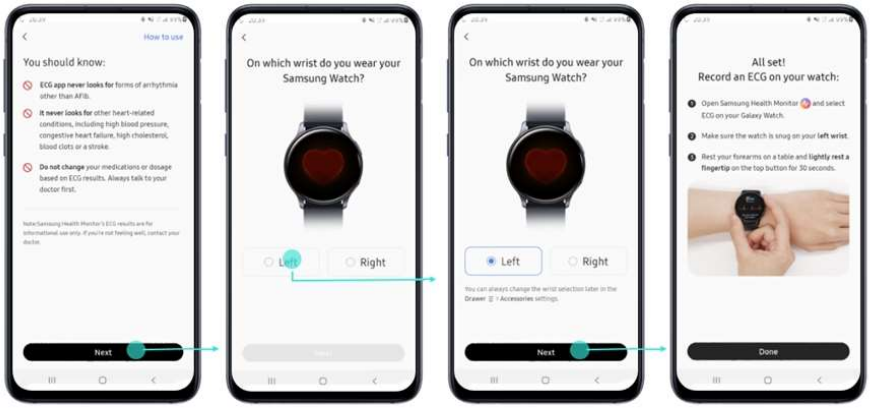
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : <Measure>

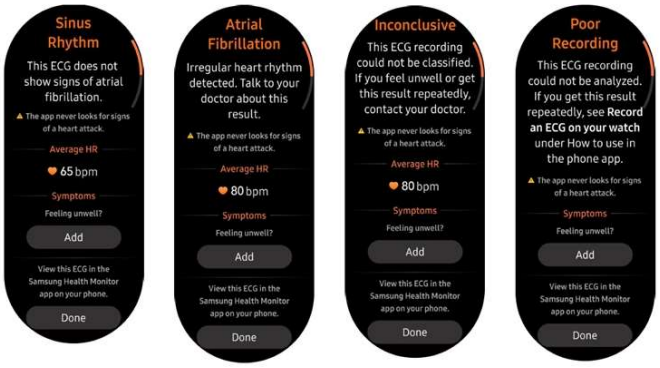
4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

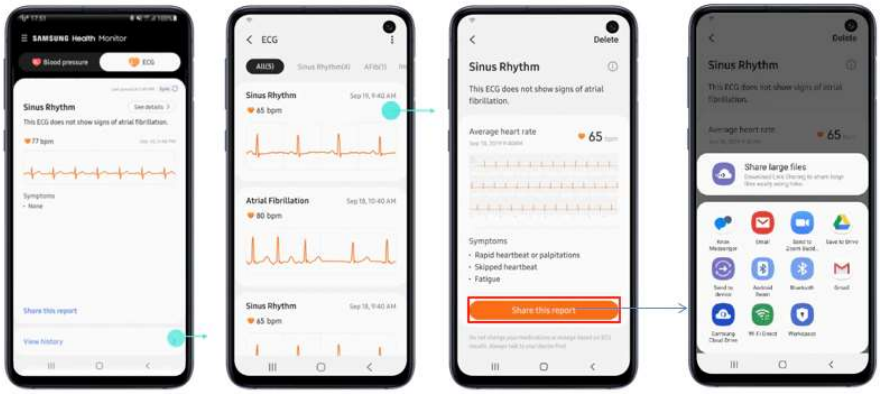
Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.



A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



117. The algorithm used by the Accused Watches derives a heart beat interval, including as shown below. https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/ .

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

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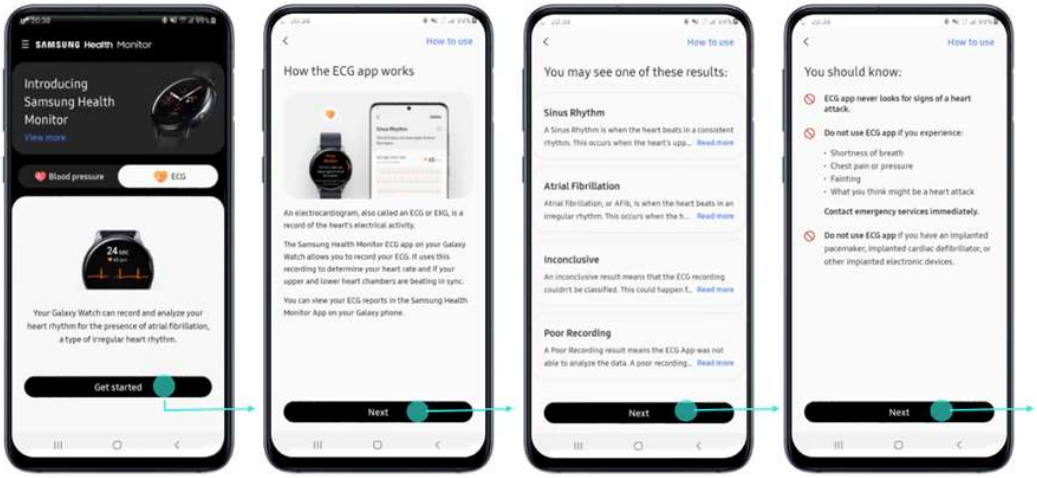
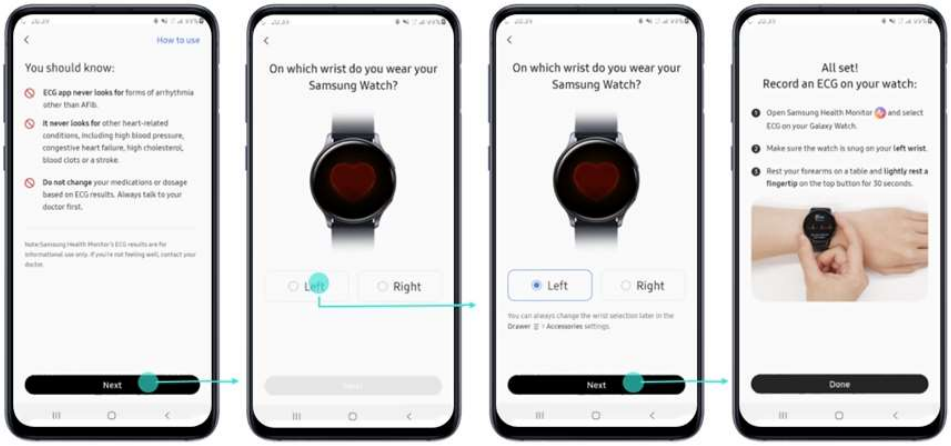
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : **<Measure>**

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A : 5. Various different ECG results may occur.

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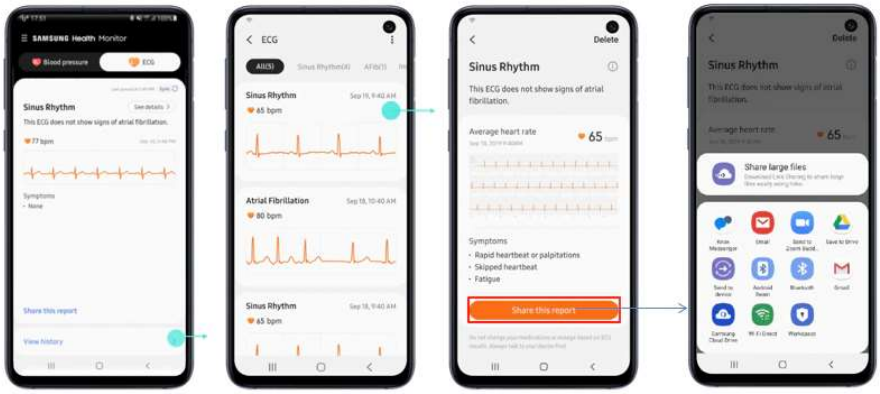
A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.

A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



118. The algorithm used by the Accused Watches analyzes a number (N) of heart beat intervals from the output, including as shown below.

https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device.

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

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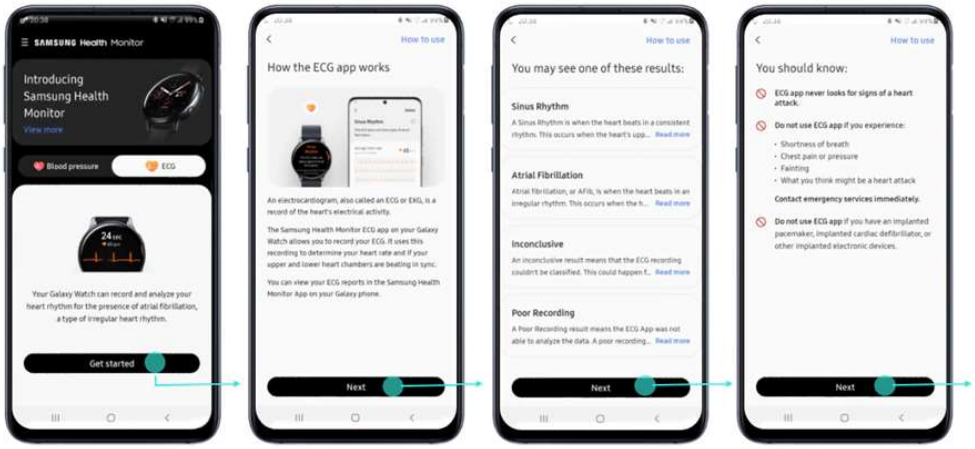
2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

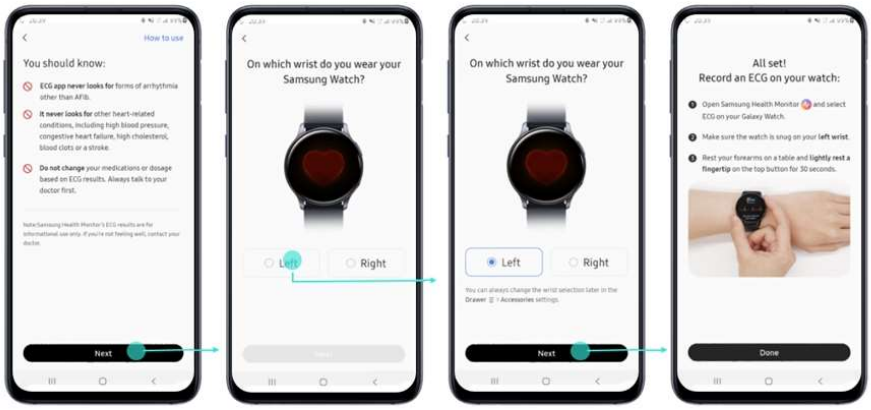
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : **<Measure>**

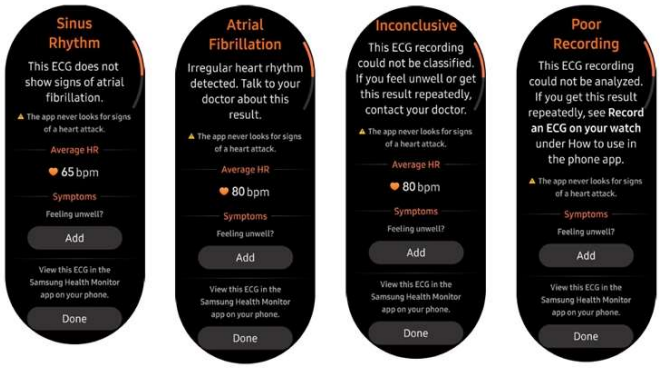
4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

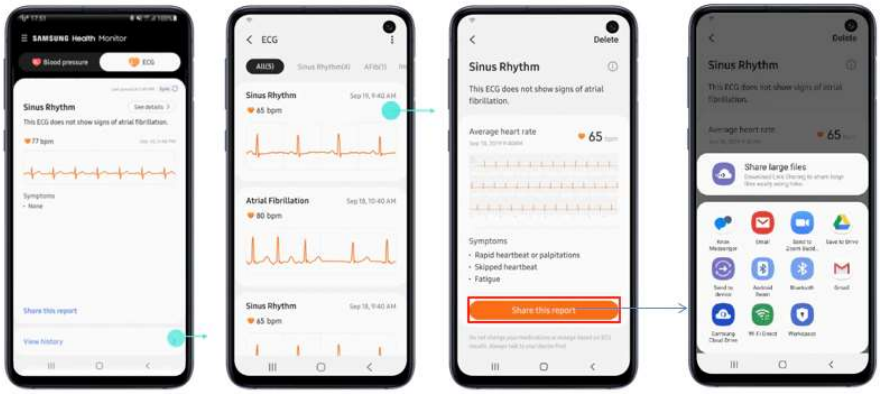
Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.



A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



119. On information and belief, the algorithm used by the Accused Watches in detecting a likelihood of AF by calculating a Turning Points Ratio (TPR) of the N heart beat intervals, calculating a root mean square of successive (RMSSD) heart beat intervals, and calculating Shannon Entropy (SE) of the N heart beat intervals.

120. All of the Accused Watches include the Samsung Health Monitor app software. This app allows the wearer to utilize the Accused Watches' ECG technology. Samsung states on its website: "The Samsung Health Monitor ECG app detects ECG signals (similar to a Lead I ECG) with the help of your Galaxy Watch's ECG sensor and determines whether atrial fibrillation or normal sinus rhythm is present. The Samsung Health Monitor ECG app creates, records, saves, and exports ECG data." This capability is shown in the image below found on the Samsung website: https://www.samsung.com/us/apps/samsung-health-monitor/.

121. On information and belief, Defendants had knowledge of Plaintiffs' AF detection algorithm and apparatus as claimed in Claim 1 through their previous work together, and Plaintiffs' disclosure of the algorithm through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

122. Defendants' infringement of the '326 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data from working with Dr. Chon, coupled with public disclosure of his AF detection algorithm and apparatus, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

123. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as their communication with him through the years of 2015-2018. Defendants either knew or took active steps to avoid learning of the '326 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

124. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for

signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2.

125. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was

discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

126. The '326 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

127. In addition to the innovations set forth, the '326 patent overcame the limitation of having to obtain large databases of training data for AF detection and instead, provides for combining statistical techniques without the need for training data, allowing for higher accuracy in AF detection.

128. For the reasons set forth, the '326 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 1.

129. Because of Defendants' infringement of the '326 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

130. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '326 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '326 patent and active inducement of infringement of the '326 patent.

131. Samsung has infringed and continues to infringe the '326 patent by making, using, selling, offering to sell, and/or importing, without license or authority,

the Accused Watches as alleged herein, which embody or use the inventions claimed in the '326 patent literally or under the doctrine of equivalents.

132. Samsung has induced infringement and continues to induce infringement of the '326 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '326 patent literally or under the doctrine of equivalents.

133. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make, use, sell, offer to sell and/or import the Accused Watches. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '326 patent, as described and alleged herein.

134. Plaintiffs reserve the right to assert additional claims of the '326 patent that Defendants infringe.

135. On information and belief, Samsung has known of the existence of the '326 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the '326 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count II: Infringement of United States Patent No. 8,718,753 by Samsung

136. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

137. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '753 patent under at least 35 U.S.C. §271.

138. On information and belief, Defendants have directly infringed one or more claims of the '753 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

139. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '753 patent, and the above-listed Samsung Watches may infringe additional patents.

140. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

141. For example, Claim 1 covers:

> A method for detecting motion and noise artifacts in an electrocardiogram (ECG) recording, comprising:
> receiving an ECG segment;
> decomposing the received ECG segment into a sum of intrinsic mode functions;
> isolating intrinsic mode functions associated with motion and noise artifacts present within the ECG segment;
> determining randomness and variability characteristic values associated with the isolated intrinsic mode functions;
> comparing the randomness and variability characteristic values to threshold randomness and variability characteristic values; and
> determining that the received ECG segment includes motion and noise artifacts if the randomness and variability characteristic values exceed the threshold randomness and variability characteristic values.

142. On information and belief, the algorithm used by the Accused Watches detects motion and noise artifacts in an electrocardiogram (ECG) recording, including as shown below.

https://www.samsung.com/us/support/troubleshooting/TSG01203537 /,

https://www.samsung.com/us/support/troubleshooting/TSG01208783/

Samsung smart watch detects unnecessary movements as exercise

When Workout detection is turned on, your Samsung smart watch will automatically detect and record activities you perform like walking, running, and cycling. However, if you're performing other actions or movements, like driving, the watch may think you're performing a workout. You can easily turn off this feature to avoid unnecessary movement being detected as a workout.

Inaccurate or no ECG results in Samsung Health Monitor

If you can't record your ECG when using the Samsung Health Monitor app, can't see your ECG results, or are receiving poor or inconclusive results, there are a few things you can check. These include checking the Bluetooth connection between your Galaxy watch and phone, making sure you're wearing your watch correctly, and cleaning your hands and arms before recording.

I cannot record my ECG

During the recording process, check for the following:

- Your fingertip is fully covering the top button.
- You do not move your arms or talk.
- You do not press the top button, only cover it with your finger.
- Your finger is resting lightly on the top button for the 30 seconds it takes to complete the recording.

I am repeatedly getting a Poor recording result

A poor recording result means that the Samsung Health Monitor app was not able to analyze your data. You may receive a poor recording if you moved your body during a recording or if your watch did not have enough skin contact with your wrist or finger. There are a few things you can try in order to receive a proper recording.

- Clean your hand, wrist, and the back of the watch.
- Moisturize your hand and wrist with lotion.
- If your skin is cold, remove the watch and gently rub your wrist to warm up your skin. Then, put the watch back on and try recording again.
- Make sure the watch is snug on your wrist and then rest your forearms comfortably on a table or flat surface when taking the ECG.
- For better skin contact, try wearing the watch slightly away from your wrist bone and toward your elbow.

Certain physiological conditions can prevent some people from having a strong signal. This can deter the Samsung Health Monitor app from detecting and analyzing their readings.

143. The algorithm used by the Accused Watches receives an ECG segment, including as shown below. https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

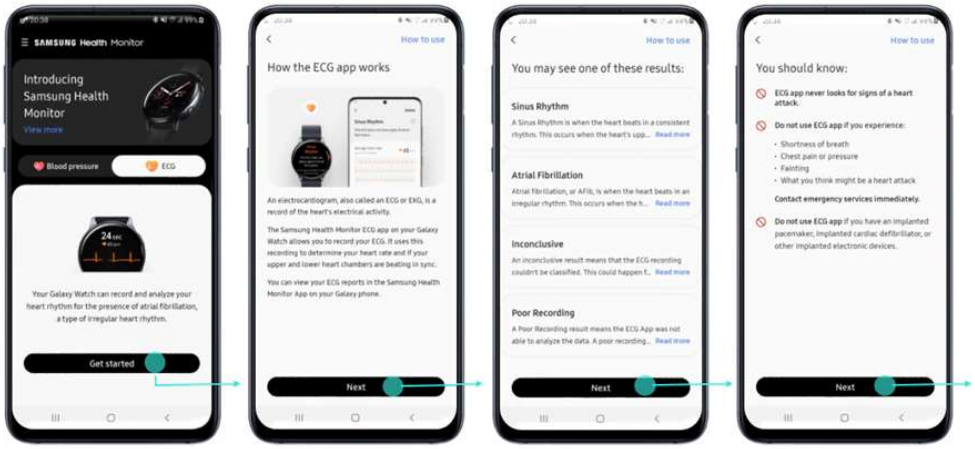
A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

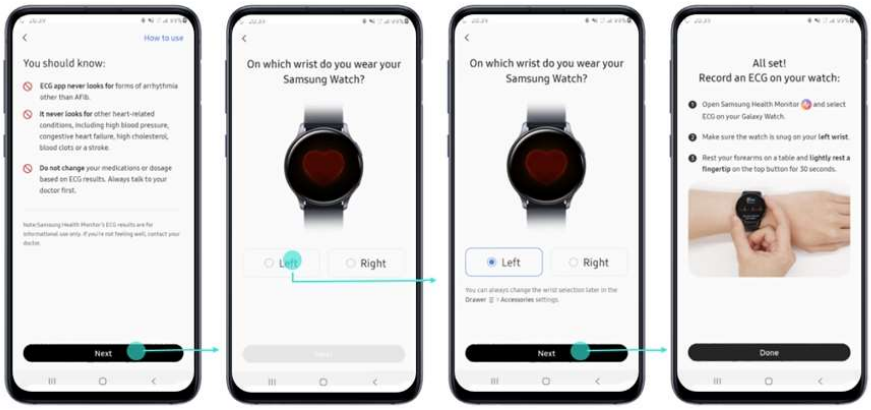
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : **<Measure>**

4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

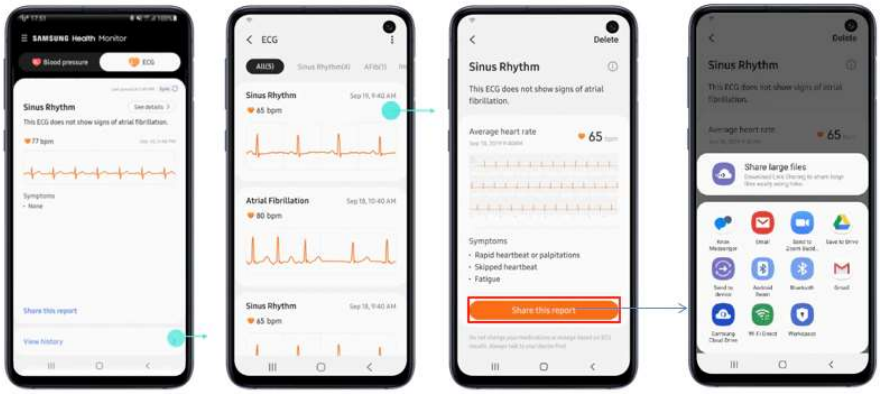
A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.

A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



144. On information and belief, the algorithm used by the Accused Watches decomposes the received ECG segment into a sum of intrinsic mode functions.

145. On information and belief, the algorithm used by the Accused Watches isolates intrinsic mode functions associated with motion and noise artifacts present within the ECG segment.

146. On information and belief, the algorithm used by the Accused Watches determines randomness and variability characteristic values associated with the isolated intrinsic mode functions.

147. On information and belief, the algorithm used by the Accused Watches compares the randomness and variability characteristic values to threshold randomness and variability characteristic values.

148. On information and belief, the algorithm used by the Accused Watches determines that the received ECG segment includes motion and noise artifacts if the randomness and variability characteristic values exceed the threshold randomness and variability characteristic values.

149. The Accused Watches possess software capable of detecting/tracking a wearer's motions through a motion sensor used in the Samsung Health Monitor app in order to output the motion signal. Rhythmic movements give users better results than irregular movements. These irregular movements are representative of motion artifacts in the heart-related signal. This capability is shown in the image below found on the

Samsung website:

https://www.samsung.com/us/support/troubleshooting/TSG01203537/

150. On information and belief, Defendants had knowledge of Plaintiffs' motion and noise artifact detection for ECG data as claimed in Claim 1 through their previous work together, and through Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

151. Defendants' infringement of the '753 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data from working with Dr. Chon, coupled with public disclosure of his AF detection algorithm and apparatus, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

152. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as their communications with him through the years of 2015-2018. Defendants either knew or took active steps to avoid learning of the '753 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

153. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2.

154. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

155. The '753 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

156. In addition to the innovations set forth, the '753 patent overcame the limitation of algorithm methods that typically result in distortions, which can lead to the incorrect classification of the presence or absence of AF, and instead, a real-time motion and noise artifact detection algorithm is used to improve the accuracy of detecting an AF in an ECG signal.

157. For the reasons set forth, the '753 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 2.

158. Because of Defendants' infringement of the '753 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

159. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '753 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '753 patent and active inducement of infringement of the '753 patent.

160. Samsung has infringed and continues to infringe the '753 patent by making, using, selling, offering to sell, and/or importing, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '753 patent literally or under the doctrine of equivalents.

161. Samsung has induced infringement and continues to induce infringement of the '753 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '753 patent literally or under the doctrine of equivalents.

162. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make,

use, sell, offer to sell and/or import the Accused Watches. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '753 patent, as described and alleged herein.

163. Plaintiffs reserve the right to assert additional claims of the '753 patent that Defendants infringe.

164. On information and belief, Samsung has known of the existence of the '753 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the '753 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count III: Infringement of United States Patent No. 9,408,576 by Samsung

165. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

166. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '576 patent under at least 35 U.S.C. § 271.

167. On information and belief, Defendants have directly infringed one or more claims of the '576 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

168. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '576 patent, and the above-listed Samsung Watches may infringe additional patents.

169. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

170. For example, Claim 1 covers:

> A computer implemented method for discriminating between atrial fibrillation and premature ventricular contractions (PVC) and premature atrial contractions (PACs), the method comprising:
>
> demarcating boundaries in a Poincare plot space, the boundaries being obtained from data from a test set of test subjects; the Poincare plot space being a space of time interval between consecutive pulses obtained by sensing variability in heart rate signal;
>
> constructing a Poincare plot of time interval data from a subject under test; the time interval being a time interval between consecutive pulses obtained by sensing variability in heart rate signal from the subject under test;
>
> identifying data in patterns in the Poincare plot, the patterns including patterns corresponding to combinations of at least one of bigeminy, trigemini, and quadragemini indicating one of PAC or PVC;
>
> obtaining updated data by subtracting the data in the patterns corresponding to combinations of at least one of bigeminy, trigemini,

quadragemini indicating one of PAC or PVC from the time interval data from the subject under test;

obtaining a root mean squared of successive differences, a Shannon entropy and a turning point ratio for the updated data;

comparing the root mean square of successive differences to a first predetermined threshold; comparing the Shannon entropy to a second predetermined threshold;

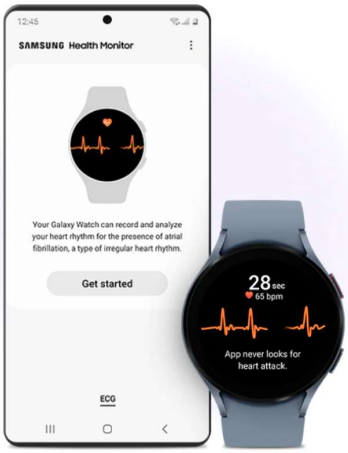
comparing the turning point ratio to a third predetermined threshold;

determining, if each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is not less than a corresponding predetermined threshold, that the subject under test has atrial fibrillation; and

determining, if each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is less than a corresponding predetermined threshold, that the subject under test has normal sinus rhythm (NSR) with PVC or PAC;

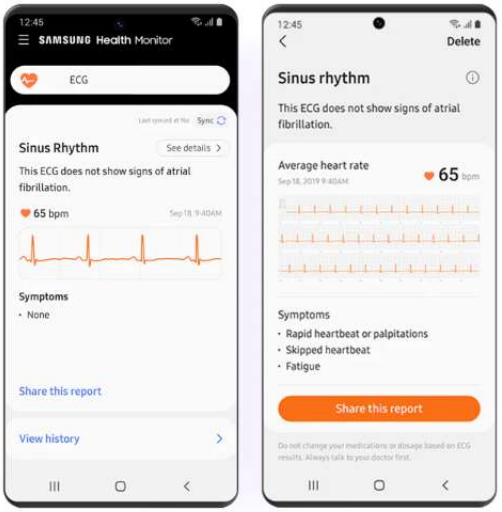
wherein demarcating boundaries in a Poincare plot space, constructing a Poincare plot, identifying data in patterns in the Poincare plot, obtain updated data, obtaining root mean squared of successive differences, Shannon entropy and turning point ratio for the updated data, comparing to predetermined thresholds, and determining whether the subject under test has atrial fibrillation or the subject under test has normal sinus rhythm (NSR) with PVC or PAC are performed by one or more processors executing computer readable code embodied in non-transitory computer usable media.

171. The algorithm used by the Accused Watches uses a computer implemented method for discriminating between atrial fibrillation and premature ventricular contractions (PVC) and premature atrial contractions (PACs), including as shown below. https://www.samsung.com/us/apps/samsung-health-monitor/ , https://developer.samsung.com/health/privileged , https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor



Take ECG measurements with Galaxy Watch

The Galaxy Watch takes ECG measurements and checks the results for irregular heartbeats and notifies you accordingly.[1]



❶ ECG report ❷ ECG report specifics

After you take an ECG, the ECG data is synced to the paired Galaxy smartphone where a PDF report is created.

1) Your ECG analysis is sent from Galaxy Watch to your Galaxy smartphone shortly after measurement.

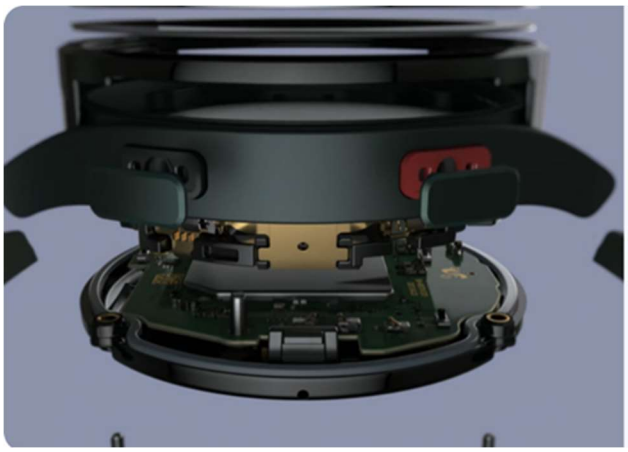
2) On the phone app, you can retrieve detailed results transmitted from your Galaxy Watch and you can see the classified results as follows:

· Sinus Rhythm: A sinus rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync. A sinus rhythm result is based only on that particular ECG recording, and doesn't mean your heart beats uniformly all the time. Also, a sinus rhythm result does not guarantee that you are not experiencing arrhythmia or another health condition. If you are not feeling well regardless of your result, contact your doctor.

· Atrial Fibrillation: Atrial Fibrillation, or AFib, is when the heart beats in an irregular rhythm. This occurs when the heart's upper chambers beat out of sync with the lower chambers. AFib is the most common form of an irregular heartbeat. If not treated, it can lead to blood clots, stroke, heart failure, and other health problems.

· Inconclusive: An inconclusive result means that the ECG recording could not be classified. This could happen if:
- The heart rate during the recording was less than 50 bpm.
- The heart rate during recording was greater than 100 bpm and the rhythm was not AFib.
- The heart rhythm was AFib and the heart rate was greater than 120 bpm. The heart rhythm was neither sinus rhythm nor AFib.
If you get this result repeatedly, contact your doctor.

· Poor recording: A poor recording result means Samsung Health Monitor was not able to analyze the data. A poor recording usually happens because your body moved during recording, or the Galaxy Watch didn't have enough skin contact with your wrist or finger. If you get this result repeatedly, see the Troubleshooting section in the Instructions For Use document.



Leveraging Galaxy Watch's Advanced...

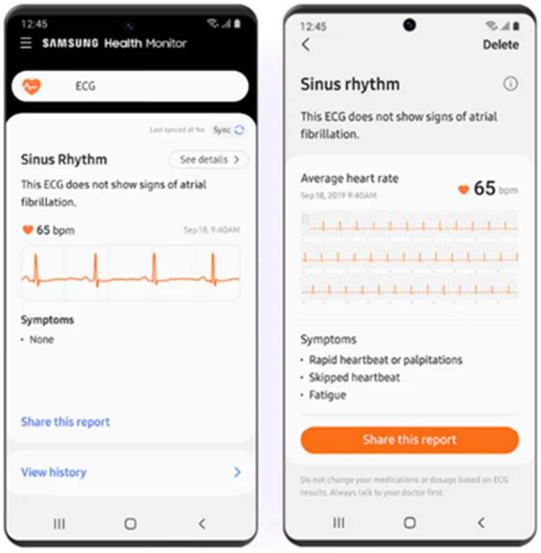
As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...

172. On information and belief, the algorithm used by the Accused Watches demarcates boundaries in a Poincare plot space, the boundaries being obtained from data from a test set of test subjects.

173. On information and belief, the algorithm used by the Accused Watches demonstrates the Poincare plot space being a space of time interval between consecutive pulses obtained by sensing variability in heart rate signal.

174. On information and belief, the algorithm used by the Accused Watches constructs a Poincare plot of time interval data from a subject under test, the time interval being a time interval between consecutive pulses obtained by sensing variability in heart rate signal from the subject under test, including as shown below.

https://www.samsung.com/us/apps/samsung-health-monitor/



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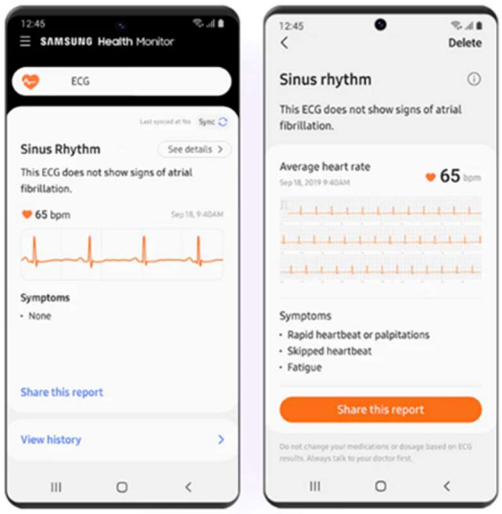
- The heart rate during the recording was less than 50 bpm.
- The heart rate during recording was greater than 100 bpm and the rhythm was not AFib.
- The heart rhythm was AFib and the heart rate was greater than 120 bpm. The heart rhythm was neither sinus rhythm nor AFib.
If you get this result repeatedly, contact your doctor.

· Poor recording: A poor recording result means Samsung Health Monitor was not able to analyze the data. A poor recording usually happens because your body moved during recording, or the Galaxy Watch didn't have enough skin contact with your wrist or finger. If you get this result repeatedly, see the Troubleshooting section in the Instructions For Use document.

175. On information and belief, the algorithm used by the Accused Watches identifies data in patterns in the Poincare plot, the patterns including patterns corresponding to combinations of at least one of bigeminy, trigemini, and quadragemini indicating one of PAC or PVC, including as shown below.

https://www.samsung.com/us/apps/samsung-health-monitor/



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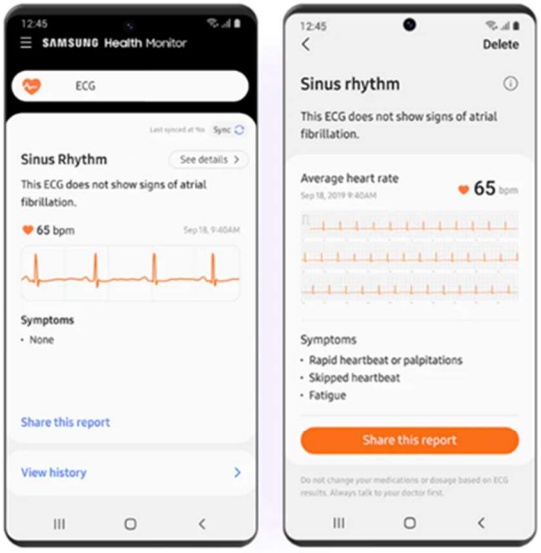
- The heart rhythm was AFib and the heart rate was greater than 120 bpm. The heart rhythm was neither sinus rhythm nor AFib.
If you get this result repeatedly, contact your doctor.

· Poor recording: A poor recording result means Samsung Health Monitor was not able to analyze the data. A poor recording usually happens because your body moved during recording, or the Galaxy Watch didn't have enough skin contact with your wrist or finger. If you get this result repeatedly, see the Troubleshooting section in the Instructions For Use document.

176. On information and belief, the algorithm used by the Accused Watches obtains updated data by subtracting the data in the patterns corresponding to combinations of at least one of bigeminy, trigemini, quadragemini indicating one of PAC or PVC from the time interval data from the subject under test, including as shown below. https://www.samsung.com/us/apps/samsung-health-monitor/



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- The heart rhythm was AFib and the heart rate was greater than 120 bpm. The heart rhythm was neither sinus rhythm nor AFib.
If you get this result repeatedly, contact your doctor.

· Poor recording: A poor recording result means Samsung Health Monitor was not able to analyze the data. A poor recording usually happens because your body moved during recording, or the Galaxy Watch didn't have enough skin contact with your wrist or finger. If you get this result repeatedly, see the Troubleshooting section in the Instructions For Use document.

177. On information and belief, the algorithm used by the Accused Watches obtains a root mean square of successive differences, a Shannon entropy, and a turning point ratio for the updated data.

178. On information and belief, the algorithm used by the Accused Watches compares the root mean square of successive differences to a first predetermined threshold, comparing the Shannon entropy to a second predetermined threshold, and comparing the turning point ratio to a third predetermined threshold.

179. On information and belief, the algorithm used by the Accused Watches determines if each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is not less than a corresponding predetermined

threshold, that the subject under test has atrial fibrillation, including as shown below.

https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

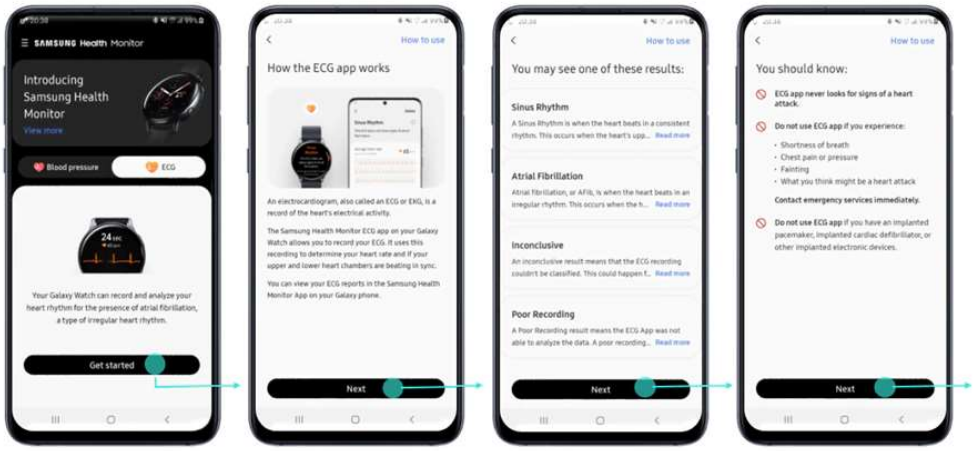
A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

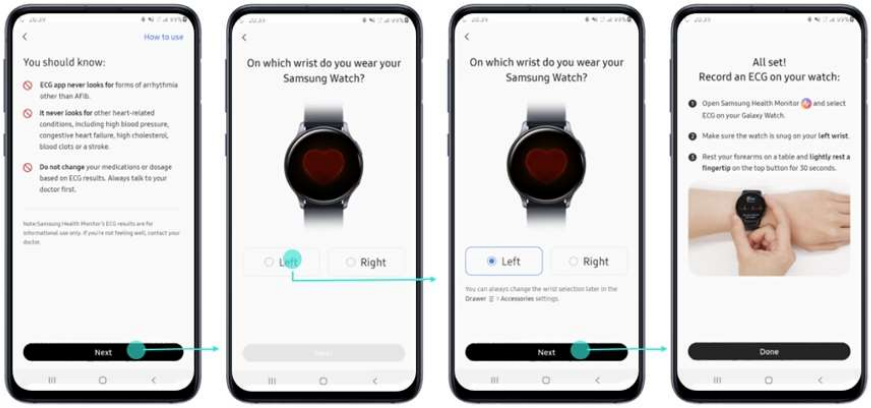
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : <Measure>

4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

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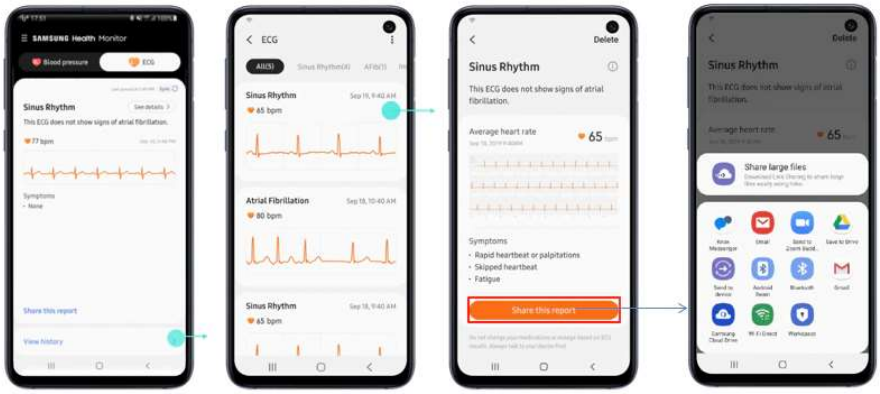
Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.

A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



180. On information and belief, the algorithm used by the Accused Watches determines if each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is less than a corresponding predetermined threshold that the subject under test has normal sinus rhythm (NSR) with PVC or PAC, including as shown below. https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/

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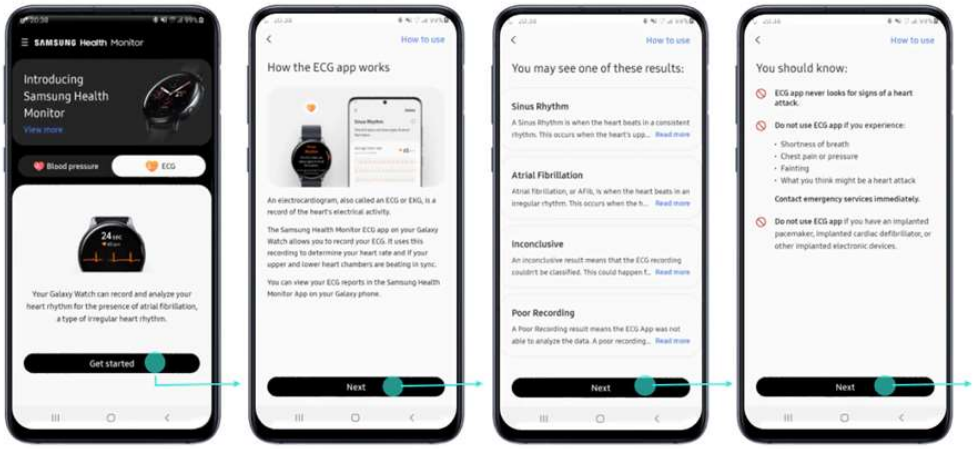

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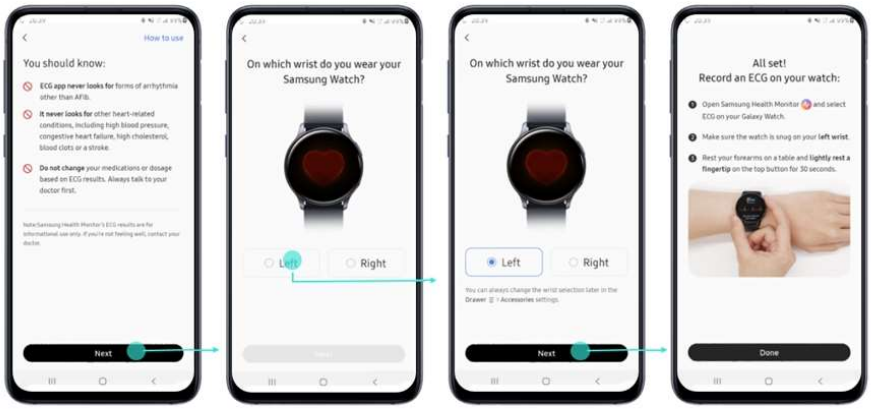

A : **<Measure>**

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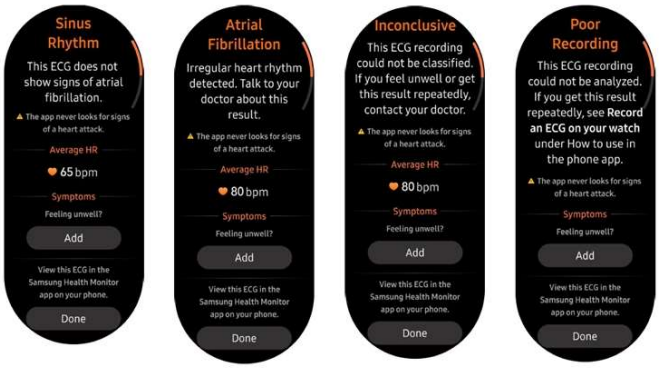

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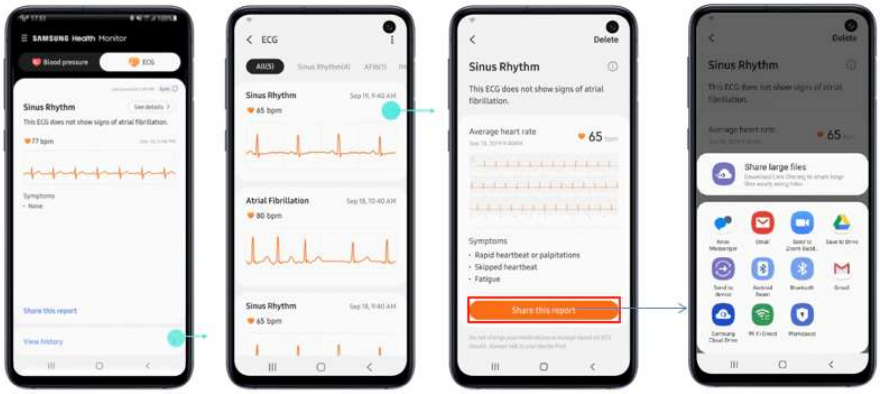

181. On information and belief, the algorithm used by the Accused Watches constructs a Poincare plot, identifies data in patterns in the Poincare plot, obtains updated data, obtains root mean squared of successive differences, Shannon entropy, and turning point ratio for the updated data, compares to predetermined thresholds, and determines whether the subject under test has atrial fibrillation or the subject under test has normal sinus rhythm (NSR) with PVC or PAC, which are performed by one or more processors executing computer readable code embodied in non-transitory computer usable media, including as shown below.

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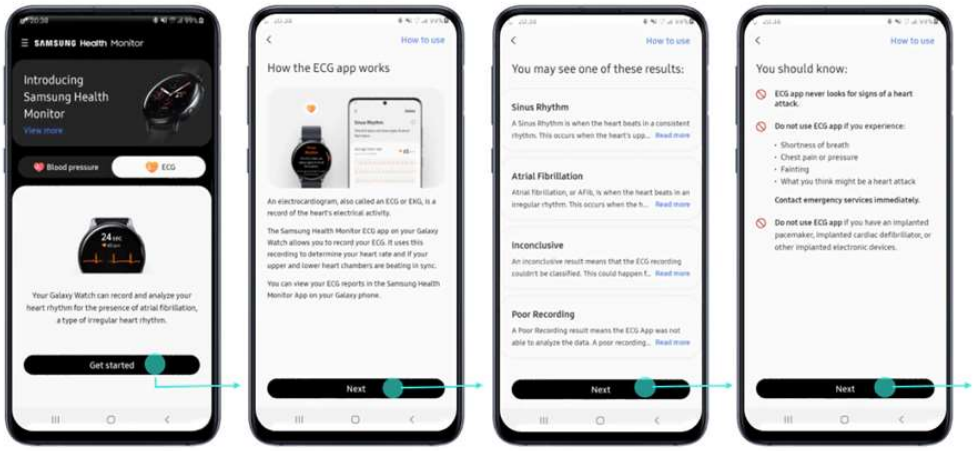

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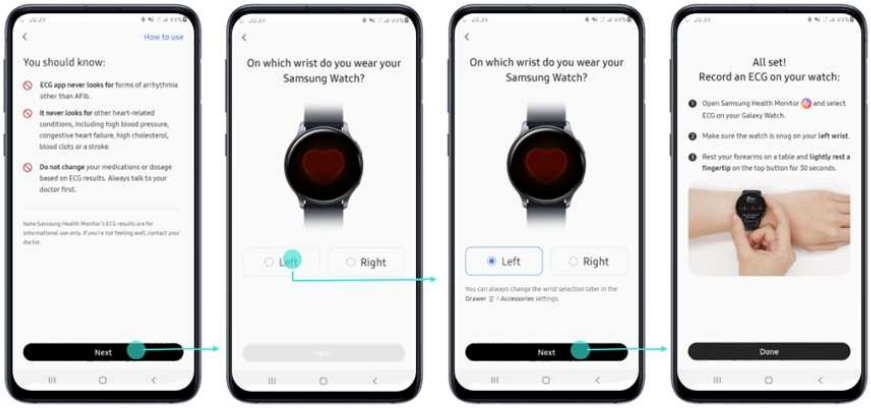

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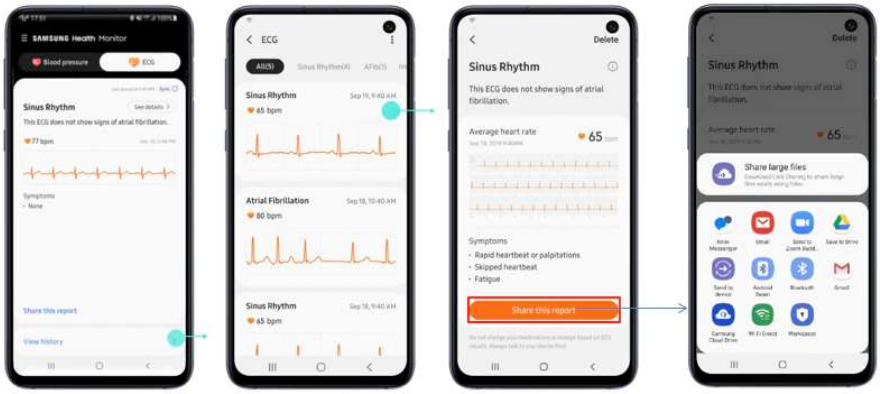
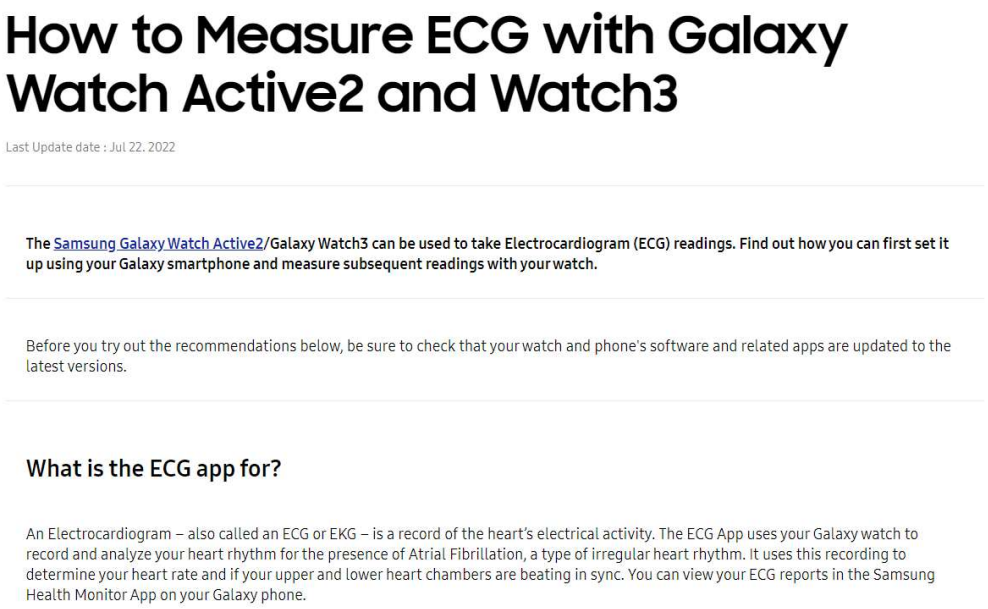


182. On information and belief, the Accused Watches utilize Plaintiffs' algorithm capable of reducing the number of false positives in AF detection by differentiating various patterns of premature atrial contractions ("PAC") and premature ventricle contractions ("PVC") from normal sinus rhythm ("NSR") and AF. This capability is shown in the image below found on the Samsung website at: https://www.samsung.com/sg/support/mobile-devices/how-to-measure-ecg-with-the-galaxy-watch/



How to Measure ECG with Galaxy Watch Active2 and Watch3

Last Update date : Jul 22. 2022

The Samsung Galaxy Watch Active2/Galaxy Watch3 can be used to take Electrocardiogram (ECG) readings. Find out how you can first set it up using your Galaxy smartphone and measure subsequent readings with your watch.

Before you try out the recommendations below, be sure to check that your watch and phone's software and related apps are updated to the latest versions.

What is the ECG app for?

An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity. The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

183. On information and belief, Defendants had knowledge of Plaintiffs' algorithm as claimed in Claim 1 through their previous work together, and through Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

184. Defendants' infringement of the '576 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data of working with Dr. Chon, coupled with public disclosure of Plaintiffs' algorithm, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

185. Defendants were fully aware of Dr. Chon's proprietary and successful claims via the data collection and results of various Simband watches, as well as their communications with him through the years of 2015-2018. Defendants either knew or

took active steps to avoid learning of the '576 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

186. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

187. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

188. The '576 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

189. In addition to the innovations set forth, the '576 patent overcame the limitation of inaccurate AF algorithm methods that typically result in distortions, which can lead to the incorrect classification of the presence or absence of AF, and instead, an algorithm for the detection of PAC/PVC from a pulse interval signal derived from a

smartphone is used as a real-time realizable and more efficient method for AF detection.

190. For the reasons set forth, the '576 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 3.

191. Because of Defendants' infringement of the '576 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

192. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '576 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '576 patent and active inducement of infringement of the '576 patent.

193. Samsung has infringed and continues to infringe the '576 patent by making, using, selling, offering to sell, and/or importing, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '576 patent literally or under the doctrine of equivalents.

194. Samsung has induced infringement and continues to induce infringement of the '576 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '576 patent literally or under the doctrine of equivalents.

195. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make, use, sell, offer to sell and/or import the Accused Watches. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '576 patent, as described and alleged herein.

196. Plaintiffs reserve the right to assert additional claims of the '576 patent that Defendants infringe.

197. On information and belief, Samsung has known of the existence of the '576 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the '576 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count IV: Infringement of United States Patent No. 9,713,428 by Samsung

198. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

199. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '428 patent under at least 35 U.S.C. §271.

200. On information and belief, Defendants have directly infringed one or more claims of the '428 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

201. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '428 patent, and the above-listed Samsung Watches may infringe additional patents.

202. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

203. For example, Claim 1 covers:

> A method for physiological parameter monitoring, the method comprising:
>
> providing a physiological indicator signal to a handheld mobile communication device; the physiological indicator signal being obtained from one of an image acquisition component, a photoplethysmographic (PPG) sensor and an electrocardiogram sensor;
>
> analyzing, using the handheld mobile communication device, the physiological indicator signal;
>
> obtaining, from said analyzing, measurements of one or more physiological parameters; and

detecting, using the handheld mobile communication device and using only the measurements of one or more physiological parameters, effects of motion artifacts in the measurements of the one or more physiological parameters and deciding whether to retain the measurements based on detected effects of motion artifacts;

wherein detecting effects of motion artifacts in the measurements comprises:

a. bandpass filtering and detrending a segment from the measurement of one physiological parameter; wherein a bandpass filtered and detrended segment is hereinafter referred to as a preprocessed segment;

b. obtaining a value of at least one indicator of volatility, used in determining whether motion artifacts are present, for the preprocessed segment; the at least one indicator of volatility being at least Shannon entropy (SE) for the preprocessed segment; where

$$SE = -\sum_{i=1}^{k} \frac{p(i) * \log(p(i))}{\log\left(\frac{1}{k}\right)}$$

and where i represents the bin number and, p(i) is the probability distribution of the preprocessed segment;

c. including the segment in analyses of physiological measurements, when comparison of the value of the at least one indicator of volatility with a predetermined threshold indicates noise/motion artifacts are not present; and

d. selecting another segment of the signal from the physiological measurement and proceeding to step (a) when the value of the at least one indicator of volatility is less than a predetermined threshold and when another segment is available.

204. The algorithm used by the Accused Watches does physiological parameter monitoring, including as shown below.

https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/ , https://www.samsung.com/au/support/mobile-devices/measure-blood-oxygen-levels/ ,

https://www.samsung.com/au/watches/galaxy-watch5/buy /

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

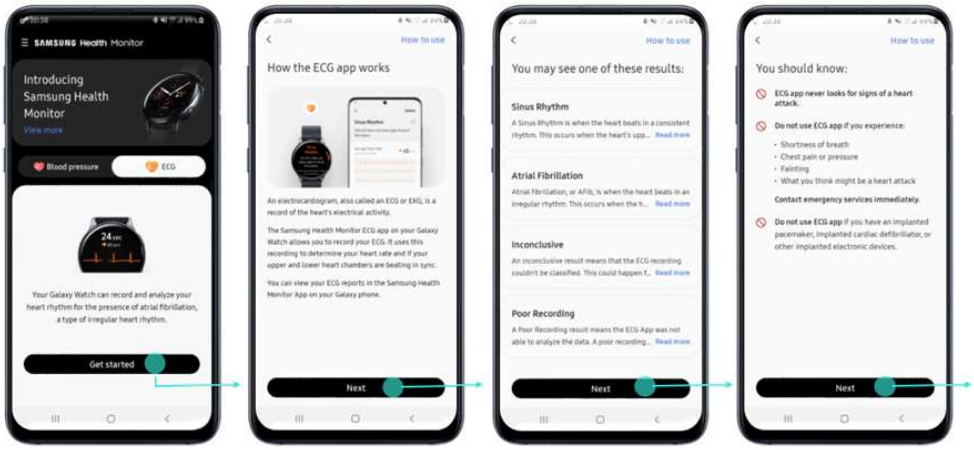
A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

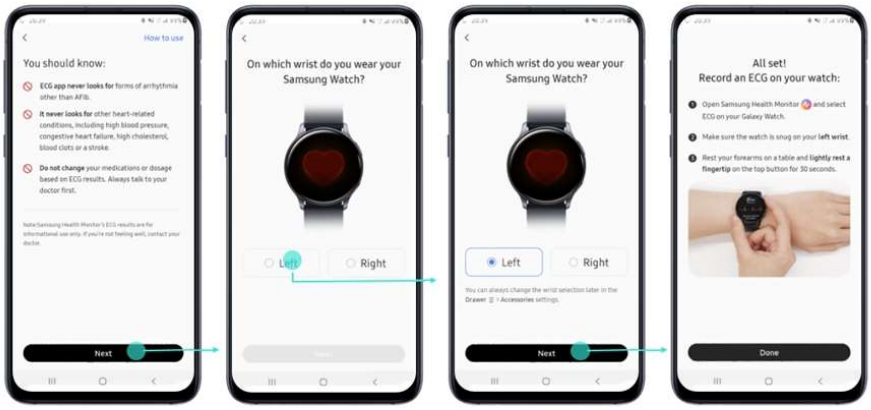
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : **<Measure>**

4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

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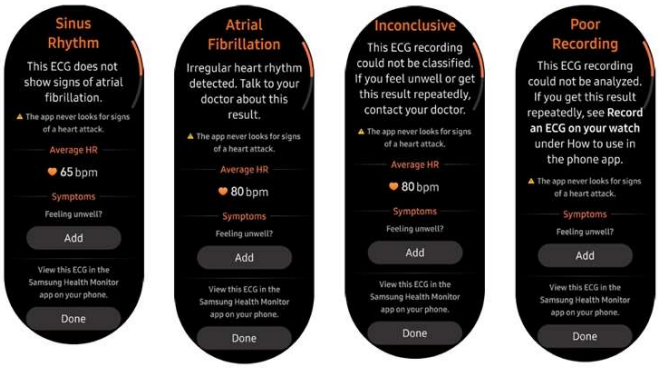
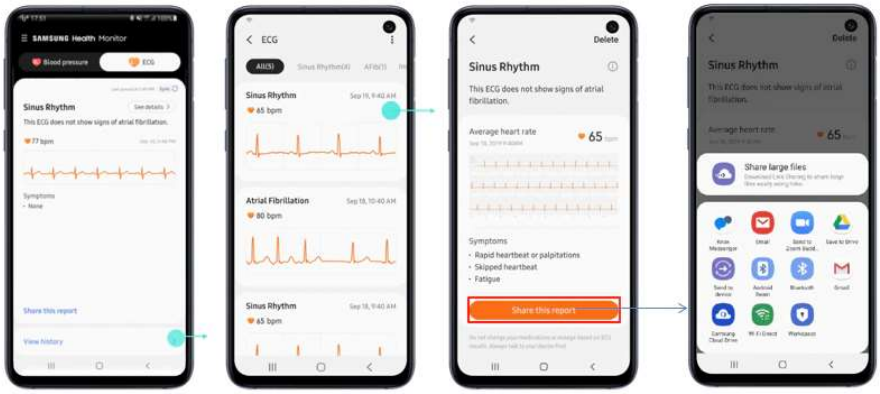


A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



Measuring Blood Oxygen Levels on my Galaxy Watch3

Last Update date : Oct 27. 2020

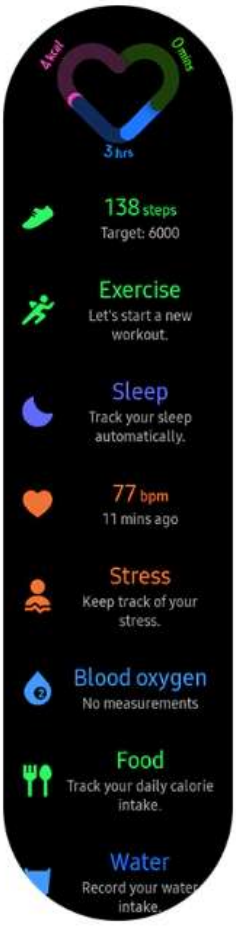
Use your Galaxy Watch3 to measure your Blood Oxygen level. Your blood oxygen level can provide an indication of how effectively your blood is carrying oxygen throughout your body, which in turn can tell you whether you're breathing effectively. Follow the below guide to learn how to setup and measure your Blood Oxygen level on your Galaxy Watch3.

"*Galaxy Watch 3 is not a medical/therapeutic device and is not intended for medical use. It is solely intended for fitness and wellness purposes only and is not intended for use in the diagnosis of disease or other conditions; or in the cure, mitigation, treatment or prevention of disease; or for the prevention or control of pregnancy. Samsung recommends that you consult with your doctor before participating in any exercise program. Using Samsung Health app with Galaxy Watch 3 requires signup and pairing with your compatible smartphone. Fall Detection must be switched on and your Location must be enabled to share with your Emergency contact.

Prior to folloing the below guide ensure that you have updated your Galaxy Watch3 to the most latest software, checkout our guide How to update the software of my Wearable for step-by-step instructions.

1 Head into your Galaxy Watch3 **Apps Tray** and launch **Samsung Health**

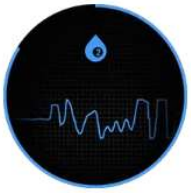
2 Scroll down the list of options and tap on **Blood Oxygen**

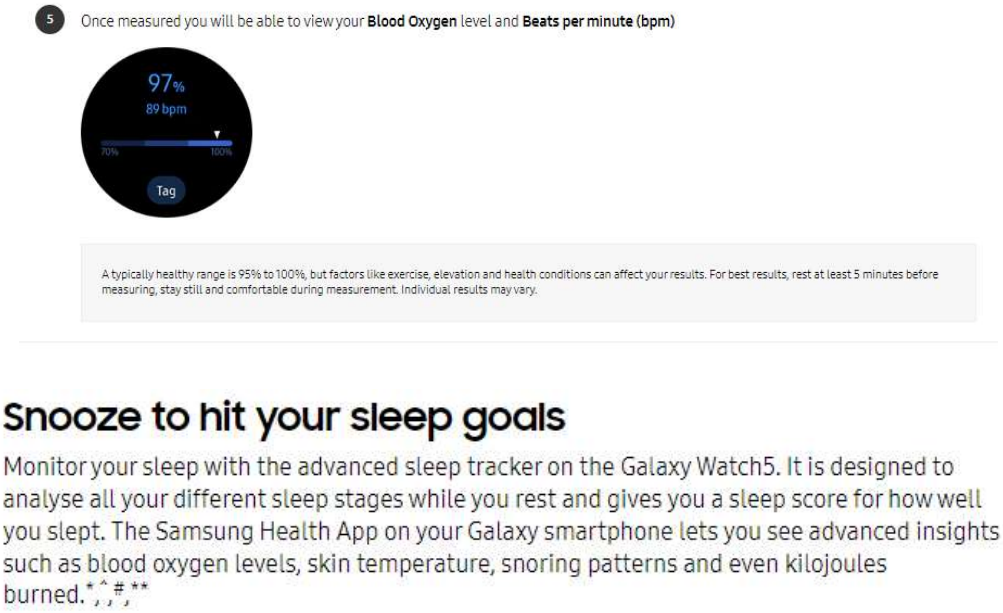


3 Select Measure

If you would like to add the Blood Oxygen function as a widget check out our guide Adding a Widget to my Samsung Watch for step-by-step instructions.

4 It is recommended to place your hand on a table and near your heart. Sit still while your watch measures your Blood Oxygen level.





205. The algorithm used by the Accused Watches provides a physiological indicator signal to a handheld mobile communication device, the physiological indicator signal being obtained from one of an image acquisition component, a photoplethysmographic (PPG) sensor and an electrocardiogram sensor, including as shown below. https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device / , https://www.samsung.com/au/support/mobile-devices/measure-blood-oxygen-levels/ , https://www.samsung.com/au/watches/galaxy-watch5/buy/ , https://developer.samsung.com/health/privileged , https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor

A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

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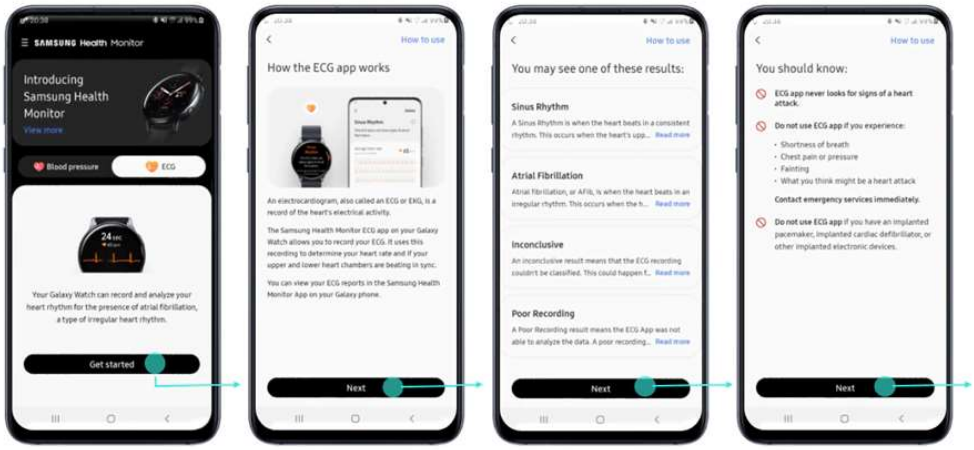

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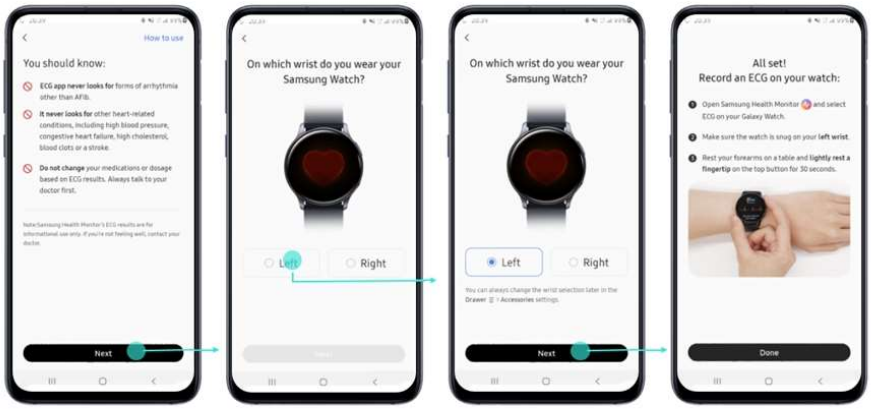

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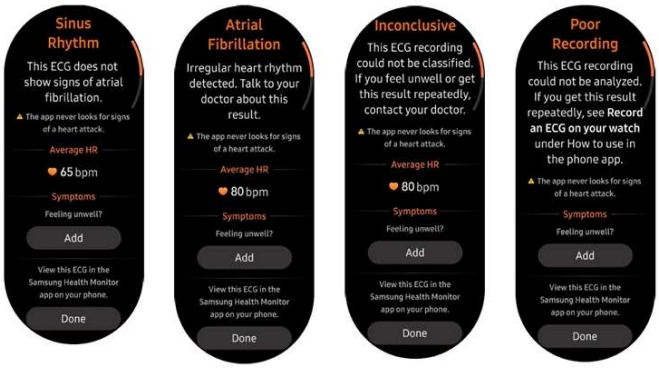

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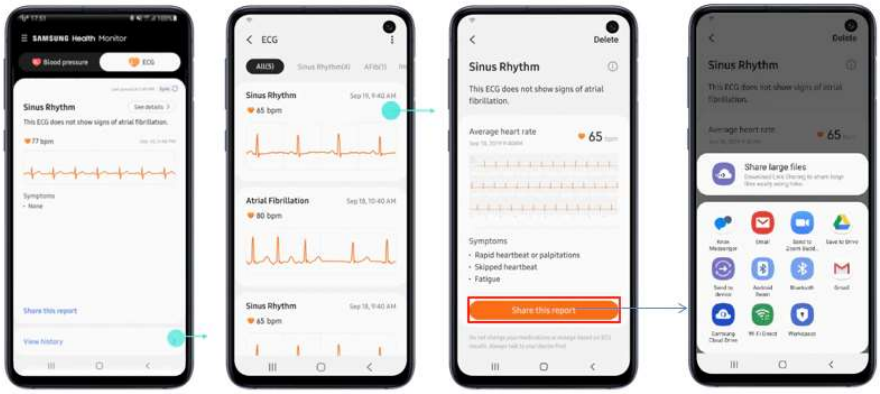

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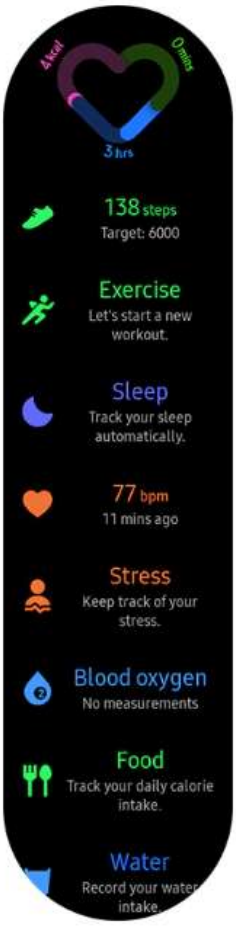

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If you would like to add the Blood Oxygen function as a widget check out our guide Adding a Widget to my Samsung Watch for step-by-step instructions.

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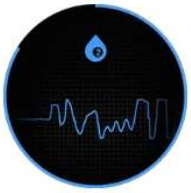
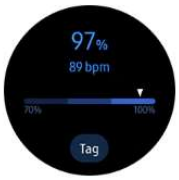


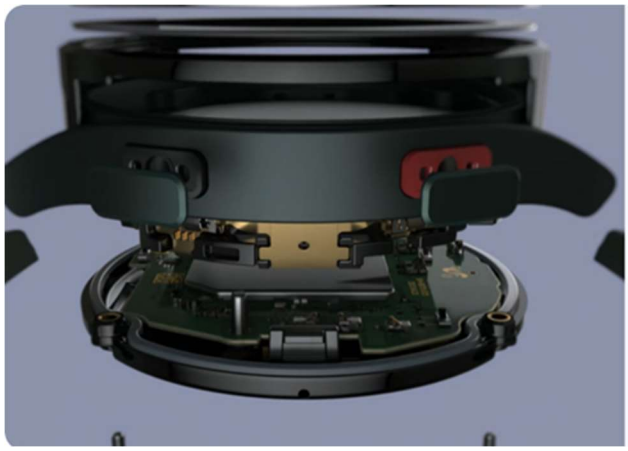
5 Once measured you will be able to view your **Blood Oxygen** level and **Beats per minute (bpm)**



A typically healthy range is 95% to 100%, but factors like exercise, elevation and health conditions can affect your results. For best results, rest at least 5 minutes before measuring, stay still and comfortable during measurement. Individual results may vary.

Snooze to hit your sleep goals

Monitor your sleep with the advanced sleep tracker on the Galaxy Watch5. It is designed to analyse all your different sleep stages while you rest and gives you a sleep score for how well you slept. The Samsung Health App on your Galaxy smartphone lets you see advanced insights such as blood oxygen levels, skin temperature, snoring patterns and even kilojoules burned.*,^,#,**



Leveraging Galaxy Watch's Advanced...

As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...

206. The algorithm used by the Accused Watches analyzes, using the handheld mobile communication device, the physiological indicator signal and obtains, from said analyzing, measurements of one or more physiological parameters, including as shown below. https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/ ,

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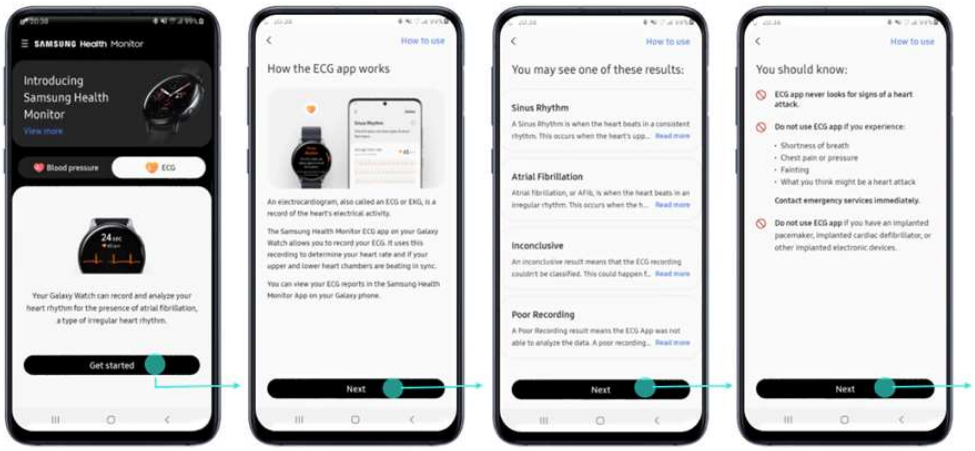

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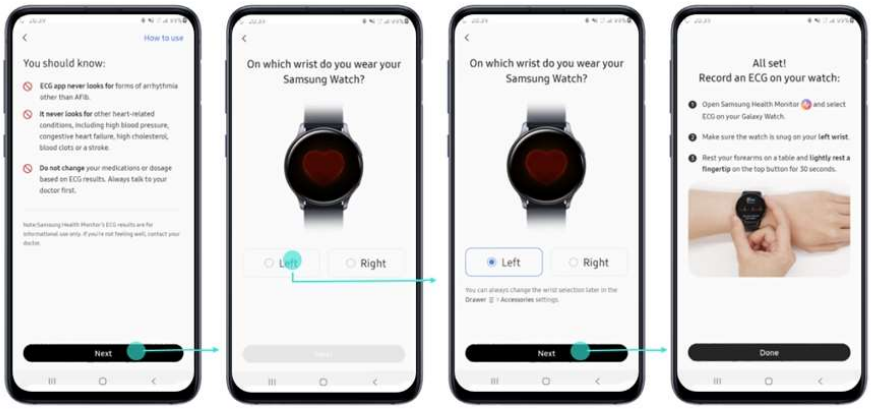

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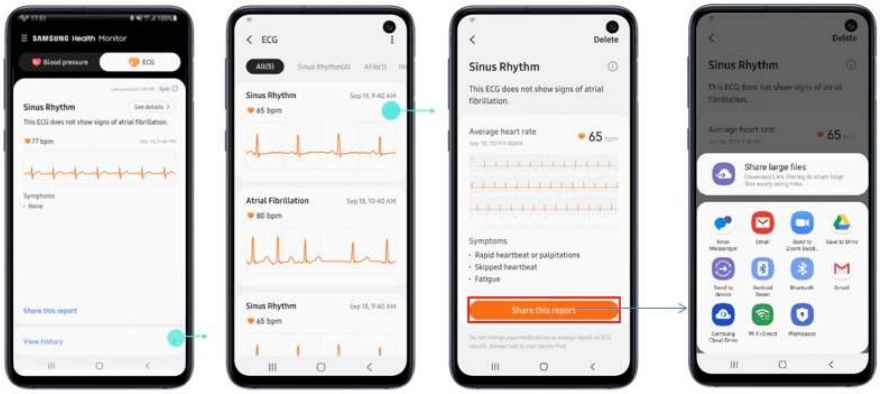

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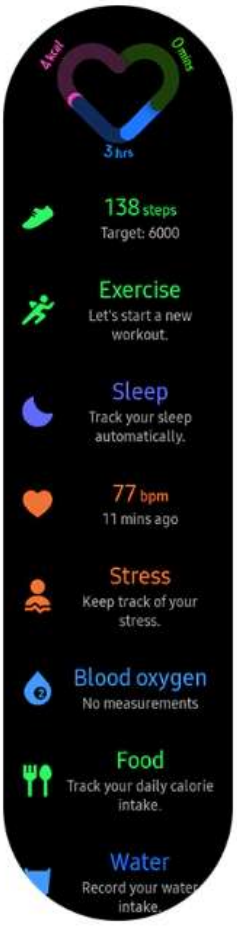

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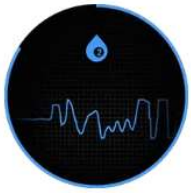
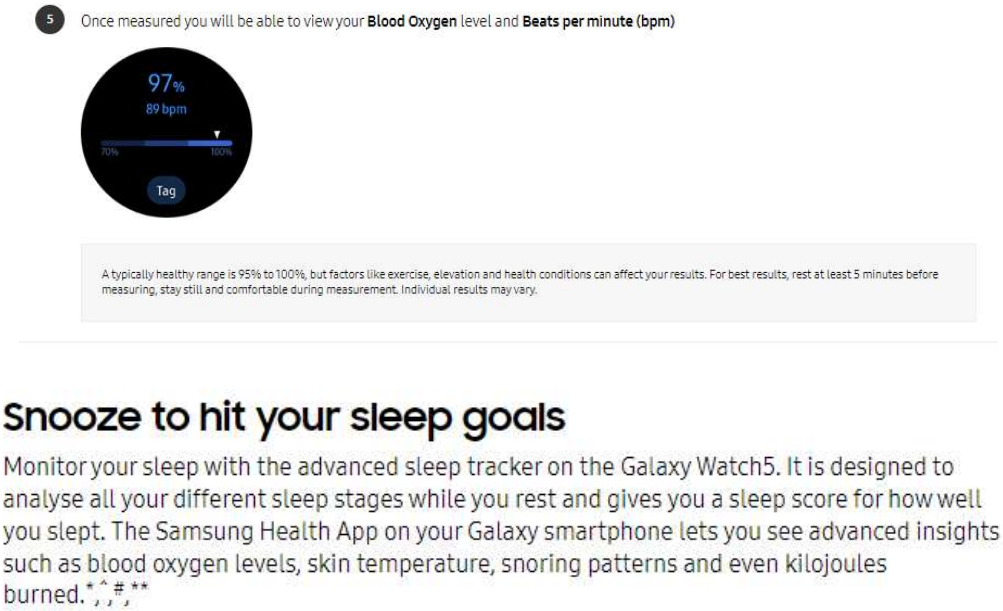




207. On information and belief, the algorithm used by the Accused Watches detects, using the handheld mobile communication device and using only the measurements of one or more physiological parameters, effects of motion artifacts in the measurements of the one or more physiological parameters and deciding whether to retain the measurements based on detected effects of motion artifacts, including as shown below.

https://www.samsung.com/us/support/troubleshooting/TSG01203537/ ,

https://www.samsung.com/us/support/troubleshooting/TSG01208783 /

Samsung smart watch detects unnecessary movements as exercise

When Workout detection is turned on, your Samsung smart watch will automatically detect and record activities you perform like walking, running, and cycling. However, if you're performing other actions or movements, like driving, the watch may think you're performing a workout. You can easily turn off this feature to avoid unnecessary movement being detected as a workout.

SAMSUNG Mobile TV & Audio Appliances Computing Displays Accessories SmartThings Offers Outlet ↗ Explore Support For Business

Home / Inaccurate or no ECG results in Samsung Health Monitor

Inaccurate or no ECG results in Samsung Health Monitor

If you can't record your ECG when using the Samsung Health Monitor app, can't see your ECG results, or are receiving poor or inconclusive results, there are a few things you can check. These include checking the Bluetooth connection between your Galaxy watch and phone, making sure you're wearing your watch correctly, and cleaning your hands and arms before recording.

I cannot record my ECG

During the recording process, check for the following:

- Your fingertip is fully covering the top button.
- You do not move your arms or talk.
- You do not press the top button, only cover it with your finger.
- Your finger is resting lightly on the top button for the 30 seconds it takes to complete the recording.

I am repeatedly getting a Poor recording result

A poor recording result means that the Samsung Health Monitor app was not able to analyze your data. You may receive a poor recording if you moved your body during a recording or if your watch did not have enough skin contact with your wrist or finger. There are a few things you can try in order to receive a proper recording.

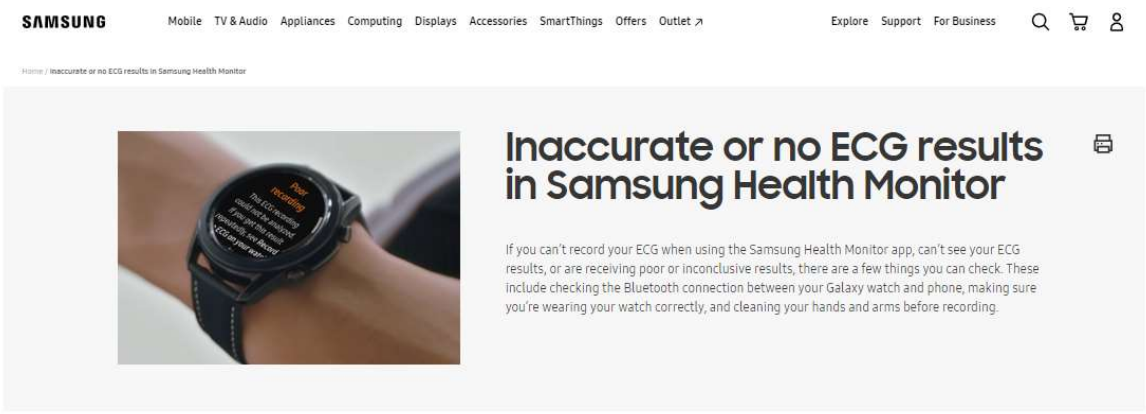
- Clean your hand, wrist, and the back of the watch.
- Moisturize your hand and wrist with lotion.
- If your skin is cold, remove the watch and gently rub your wrist to warm up your skin. Then, put the watch back on and try recording again.
- Make sure the watch is snug on your wrist and then rest your forearms comfortably on a table or flat surface when taking the ECG.
- For better skin contact, try wearing the watch slightly away from your wrist bone and toward your elbow.

Certain physiological conditions can prevent some people from having a strong signal. This can deter the Samsung Health Monitor app from detecting and analyzing their readings.

208. The algorithm used by the Accused Watches detects effects of motion artifacts in the measurements, including as shown below.

https://www.samsung.com/us/support/troubleshooting/TSG01203537/ ,

https://www.samsung.com/us/support/troubleshooting/TSG01208783/



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209. On information and belief, the algorithm used by the Accused Watches uses bandpass filtering and detrending a segment from the measurement of one

physiological parameter, wherein a bandpass filtered and detrended segment is hereinafter referred to as a preprocessed segment, as claimed in independent claim 1(a).

210. On information and belief, the algorithm used by the Accused Watches obtains a value of at least one indicator of volatility, used in determining whether motion artifacts are present, for the preprocessed segment, the at least one indicator of volatility being at least Shannon entropy (SE) for the preprocessed segment, where

$$SE = -\sum_{i=1}^{k} \frac{p(i) * \log(p(i))}{\log\left(\frac{1}{k}\right)}$$

and where i represents the bin number and, p(i) is the probability distribution of the preprocessed segment including the segment in analyses of physiological measurements, when comparison of the value of the at least one indicator of volatility with a predetermined threshold indicates noise/motion artifacts are not present; and selecting another segment of the signal from the physiological measurement and proceeding to step (a) when the value of the at least one indicator of volatility is less than a predetermined threshold and when another segment is available.

211. On information and belief, the Accused Watches utilize Plaintiffs' algorithm and system claims to enable physiological monitoring with a mobile communication device using PPG or ECG to allow for the detection of motion artifacts so that the results reported are of acceptable quality.

212. On information and belief, the Accused Watches utilize Plaintiffs' algorithm and system claims to perform physiological monitoring with a mobile communication device using PPG and ECG to allow for the detection of motion artifacts is shown in the images below found on the Samsung website at:

https://developer.samsung.com/health/privileged ,

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor ,

https://www.samsung.com/us/support/troubleshooting/TSG01203537/ ,

https://www.samsung.com/us/apps/samsung-health-monitor/ ,

https://www.samsung.com/au/support/mobile-devices/measure-blood-oxygen-levels/ , https://www.samsung.com/sg/support/mobile-devices/how-to-measure-ecg-with-the-galaxy-watch/ , https://www.samsung.com/us/watches/ ,

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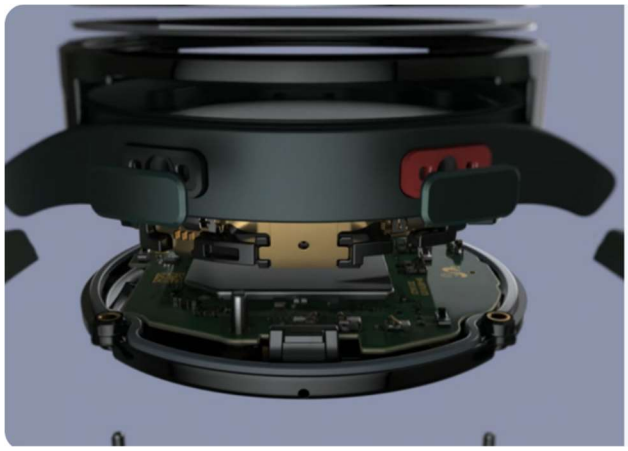

Leveraging Galaxy Watch's Advanced...

As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...

BIOACTIVE SENSOR

Tracking that's state of the heart

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An improved, **curved sensor design** gets closer to your skin for more accurate heart rate and wellness readings. [2,4]

Optical Heart Rate Sensor

Monitor your heart rate during workouts and as you recover. With heart rate sensors and more, you can optimize your performance to reach new goals. [2]

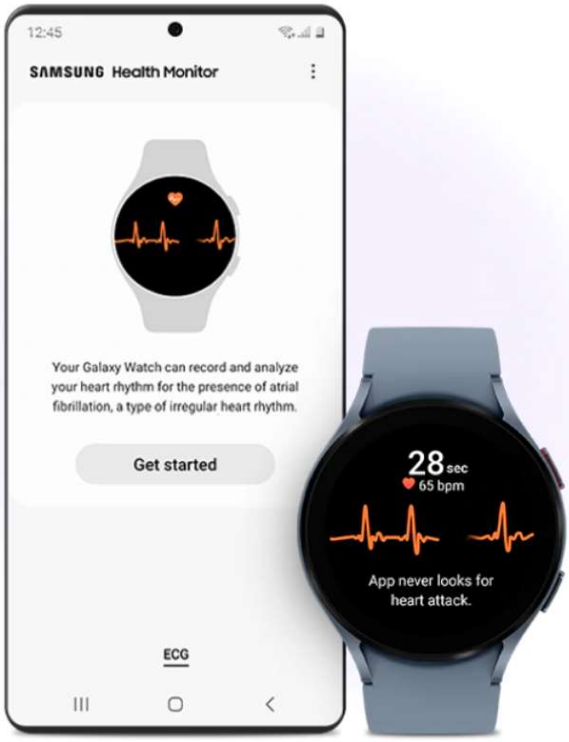
FITNESS TRACKING

Make every step count

Auto Workout Tracking automatically recognizes many popular activities like running and swimming in just minutes.[6] You can also manually track more than 90 exercises, from intense HIIT workouts to chill yoga flows.

Samsung smart watch detects unnecessary movements as exercise

When Workout detection is turned on, your Samsung smart watch will automatically detect and record activities you perform like walking, running, and cycling. However, if you're performing other actions or movements, like driving, the watch may think you're performing a workout. You can easily turn off this feature to avoid unnecessary movement being detected as a workout.


12:45
SAMSUNG Health Monitor
Your Galaxy Watch can record and analyze your heart rhythm for the presence of atrial fibrillation, a type of irregular heart rhythm.
Get started
ECG
28 sec
65 bpm
App never looks for heart attack.

Measuring Blood Oxygen Levels on my Galaxy Watch3

Last Update date : Oct 27, 2020

Use your Galaxy Watch3 to measure your Blood Oxygen level. Your blood oxygen level can provide an indication of how effectively your blood is carrying oxygen throughout your body, which in turn can tell you whether you're breathing effectively. Follow the below guide to learn how to setup and measure your Blood Oxygen level on your Galaxy Watch3.

"*Galaxy Watch 3 is not a medical/therapeutic device and is not intended for medical use. It is solely intended for fitness and wellness purposes only and is not intended for use in the diagnosis of disease or other conditions; or in the cure, mitigation, treatment or prevention of disease; or for the prevention or control of pregnancy. Samsung recommends that you consult with your doctor before participating in any exercise program. Using Samsung Health app with Galaxy Watch 3 requires signup and pairing with your compatible smartphone. Fall Detection must be switched on and your Location must be enabled to share with your Emergency contact.

Please Note: This guide is designed for Australian variant Galaxy devices, if you have an international device and require further support click here to get in touch with your Samsung subsidiary.

Prior to folloing the below guide ensure that you have updated your Galaxy Watch3 to the most latest software, checkout our guide How to update the software of my Wearable for step-by-step instructions.

1 Head into your Galaxy Watch3 **Apps Tray** and launch **Samsung Health**

How to Measure ECG with Galaxy Watch Active2 and Watch3

Last Update date : Jul 22, 2022

The Samsung Galaxy Watch Active2/Galaxy Watch3 can be used to take Electrocardiogram (ECG) readings. Find out how you can first set it up using your Galaxy smartphone and measure subsequent readings with your watch.

Before you try out the recommendations below, be sure to check that your watch and phone's software and related apps are updated to the latest versions.

What is the ECG app for?

An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity. The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

Can ECG be measured only with your watch?

The first ECG setup process requires you to use the Samsung Health Monitor app through your Galaxy smartphone. However, subsequent measurements can only be made with your Galaxy Watch Active2 or Watch3. Measured ECG records are temporarily saved to your watch and can synced with the Samsung Health Monitor app on your smartphone.

Favorite Galaxy Watch features

01 **Auto workout tracking**

02 **Battery life**

03 **Durability**

04 **Body Composition analysis**

05 **Seamless connectivity**

Sync to your Galaxy mobile devices to stay connected on excursions.[8]

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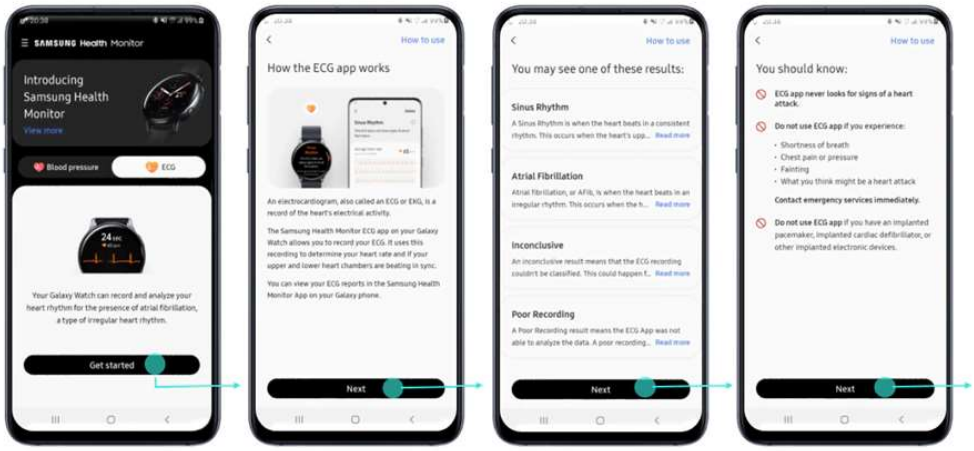

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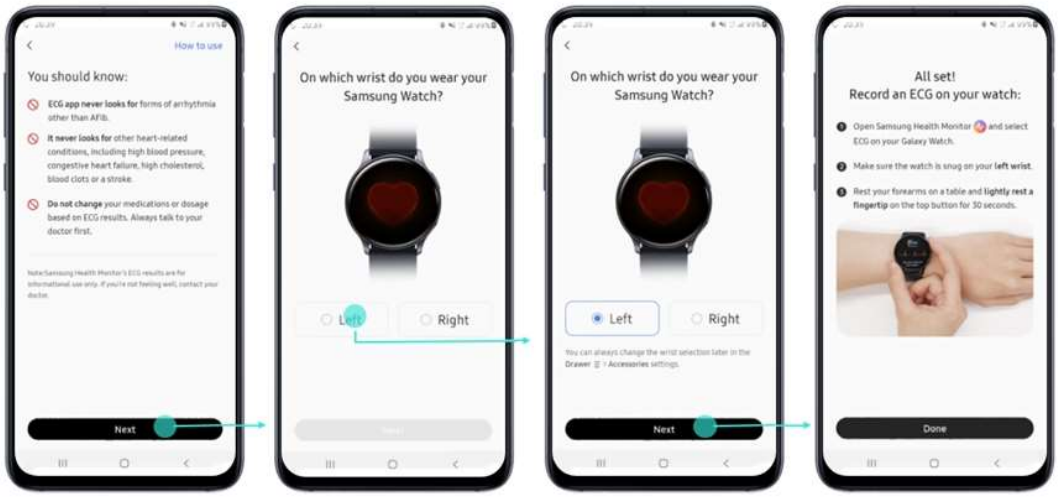

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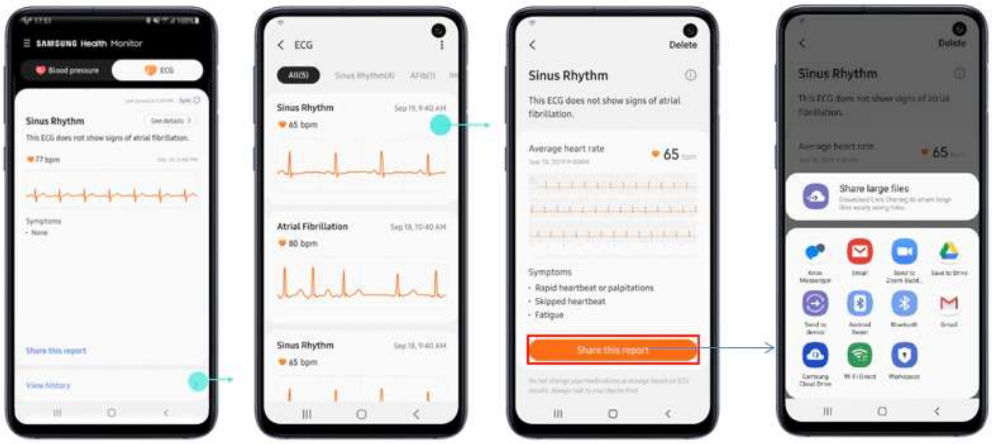


213. On information and belief, Defendants had knowledge of Plaintiffs' algorithm and systems as claimed in Claim 1 through their previous work together, and through Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

214. Defendants' infringement of the '428 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data of working with

Dr. Chon, coupled with public disclosure of Plaintiffs' algorithm and systems, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

215. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as their communications with him through the years of 2015-2018. Defendants either knew or took active steps to avoid learning of the '428 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

216. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and

REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

217. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

218. The '428 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

219. In addition to the innovations set forth, the '428 patent overcame the limitation of inaccurate AF algorithm methods that typically result in distortions, which can lead to the incorrect classification of the presence or absence of AF, and instead, an algorithm and system are used to enable physiological monitoring with a mobile communication device that allows detection of motion artifacts so that the results reported are of acceptable quality.

220. For the reasons set forth, the '428 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 4.

221. Because of Defendants' infringement of the '428 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

222. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '428 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '428 patent and active inducement of infringement of the '428 patent.

223. Samsung has infringed and continues to infringe the '428 patent by making, using, selling, offering to sell, and/or importing, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '428 patent literally or under the doctrine of equivalents.

224. Samsung has induced infringement and continues to induce infringement of the '428 patent by actively and knowingly inducing others to make, use, sell, offer to

sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '428 patent literally or under the doctrine of equivalents.

225. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make, use, sell, offer to sell and/or import the Accused Watches. For example, Samsung, or an entity under Samsung's direction or control, advertises, offers for sale, and/or otherwise promotes the Accused Watches on its website. Samsung, or one or more related entities, induces retailers and end users. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '428 patent, as described and alleged herein.

226. Plaintiffs reserve the right to assert additional claims of the '428 patent that Defendants infringe.

227. On information and belief, Samsung has known of the existence of the '428 patent and its applicability to Samsung's Watches, and committed acts of

infringement that were willful, demonstrated willful blindness, and disregard for the '428 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count V: Infringement of United States Patent No. 9,872,652 by Samsung

228. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

229. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '652 patent under at least 35 U.S.C. § 271.

230. On information and belief, Defendants have directly infringed one or more claims of the '652 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

231. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '652 patent, and the above-listed Samsung Watches may infringe additional patents.

232. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

233. For example, Claim 1 covers:

A method for reconstructing a heart-related signal output by a biomedical sensor, the method comprising:

pre-processing the heart-related signal to produce a pre-processed heart-related signal;

reconstructing a representation of the heart-related signal to produce a reconstructed representation of the heart-related signal, the reconstructing based on a time-varying spectral analysis of the pre-processed heart-related signal, the heart-related signal including motion artifacts, the motion artifacts being signal artifacts produced by movement of the biomedical sensor relative to a sensing location, the pre-processing reducing the motion artifacts in the pre-processed heart-related signal for the reconstructing, the heart-related signal being an electrocardiogram (ECG) signal; and

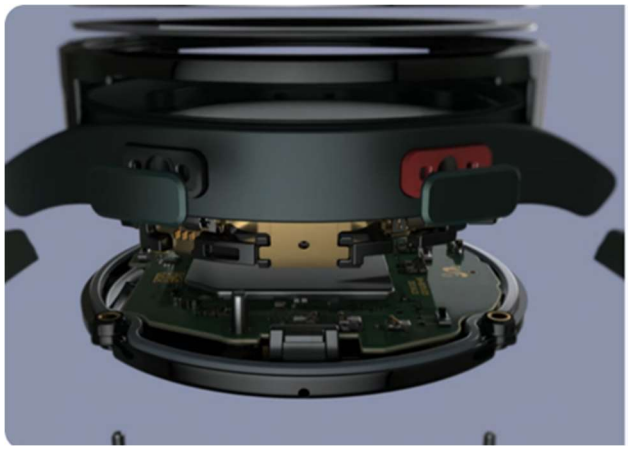
outputting the reconstructed representation of the heart-related signal.

234. The algorithm used by the Accused Watches reconstructs a heart-related signal output by a biomedical sensor, including as shown below.

https://ss7.vzw.com/is/content/VerizonWireless/samsung-noblesse-galaxy-watch3-ug , https://developer.samsung.com/health/privileged ,

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor

LTE model



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235. On information and belief, the algorithm used by the Accused Watches pre-processes the heart-related signal to produce a pre-processed heart-related signal.

236. On information and belief, the algorithm used by the Accused Watches reconstructs a representation of the heart-related signal to produce a reconstructed representation of the heart-related signal, the reconstructing is based on a time-varying spectral analysis of the pre-processed heart-related signal, the heart-related signal

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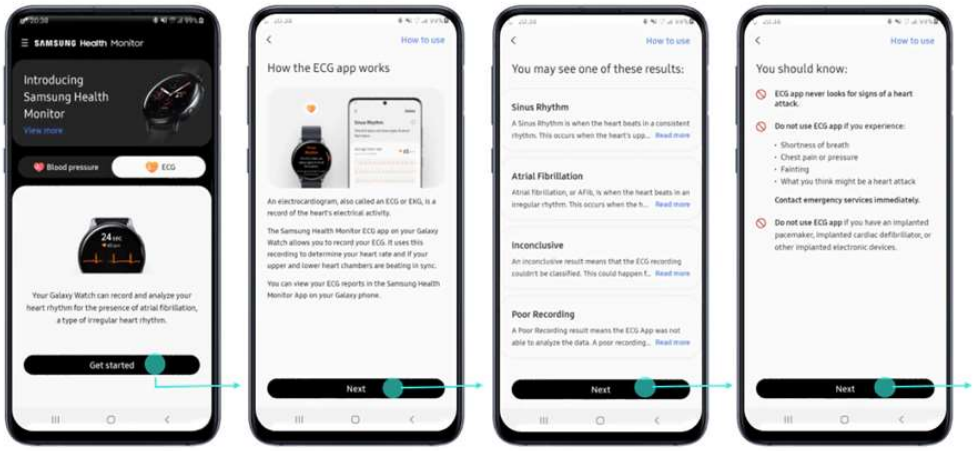

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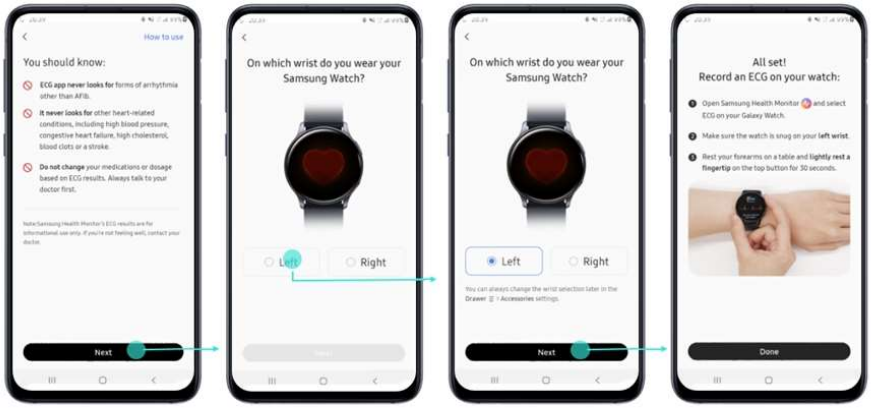

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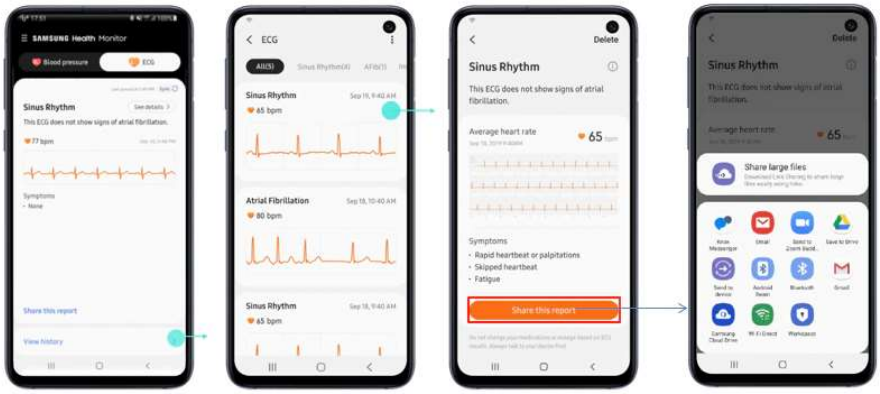

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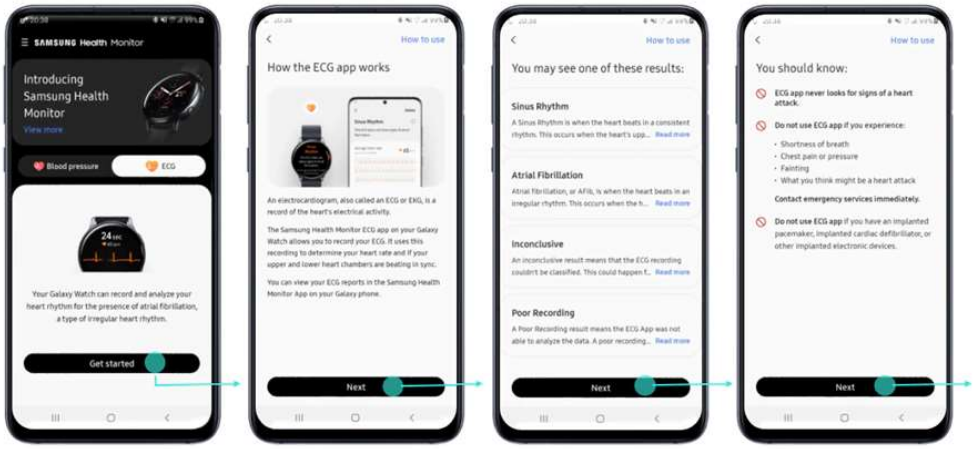

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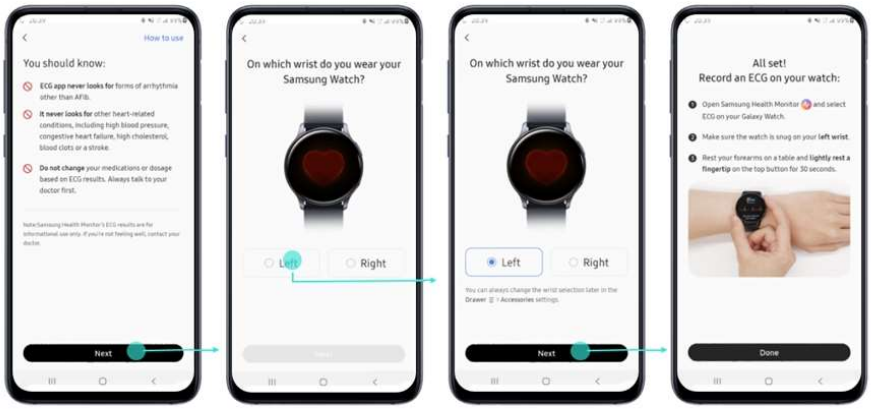

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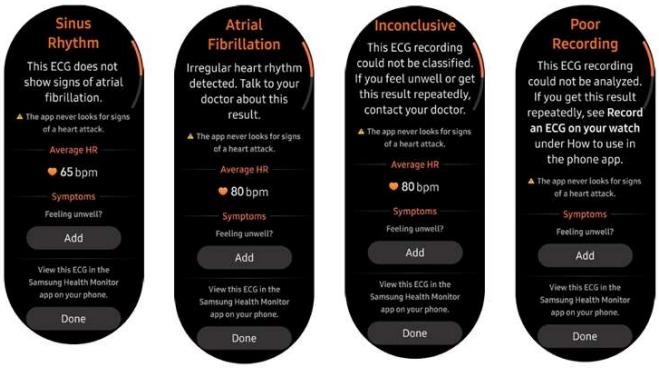

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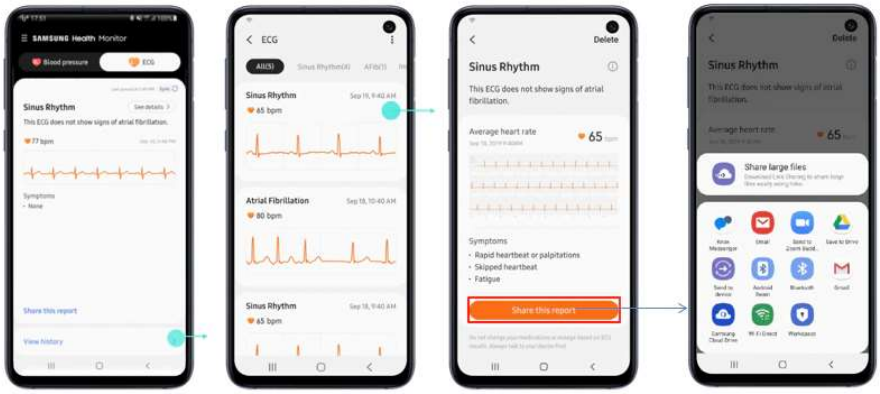
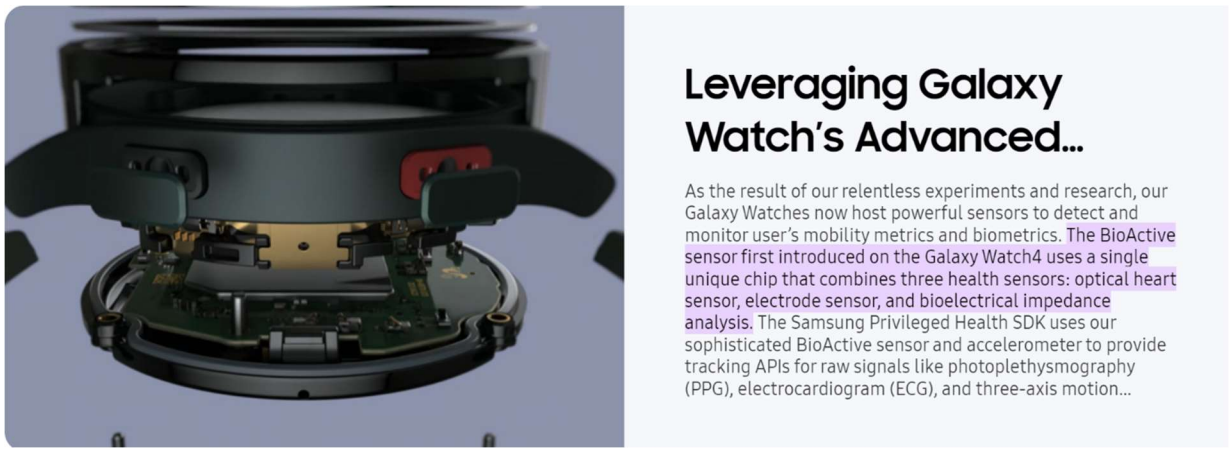


238. On information and belief, the Accused Watches utilize Plaintiffs' algorithm and apparatus claims to employ a time-varying spectral approach for reconstructing an ECG signal that includes motion artifacts.

239. On information and belief, the method and apparatus for heart rate monitoring using and ECG sensor is shown in the images below found on the Samsung website at: https://developer.samsung.com/health/privileged , https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor , https://www.samsung.com/us/support/troubleshooting/TSG01203537/ , https://www.samsung.com/us/apps/samsung-health-monitor/ , https://www.samsung.com/sg/support/mobile-devices/how-to-measure-ecg-with-the-galaxy-watch/ , https://www.samsung.com/us/watches/ , https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/



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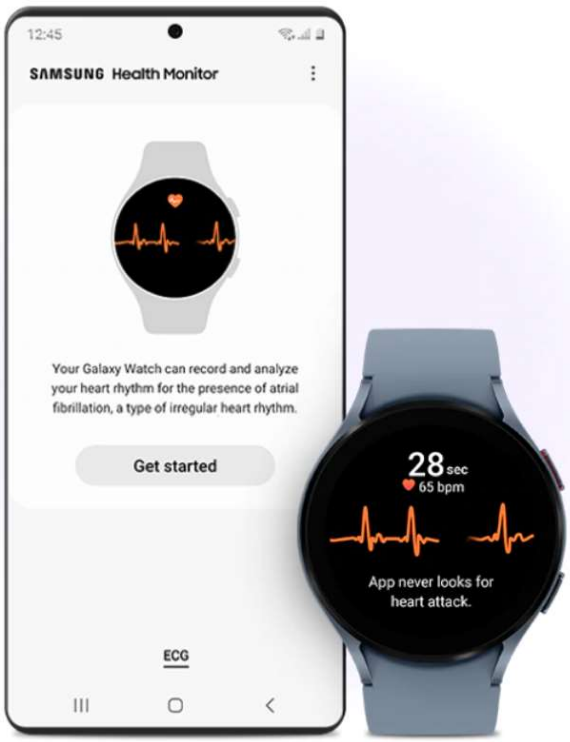

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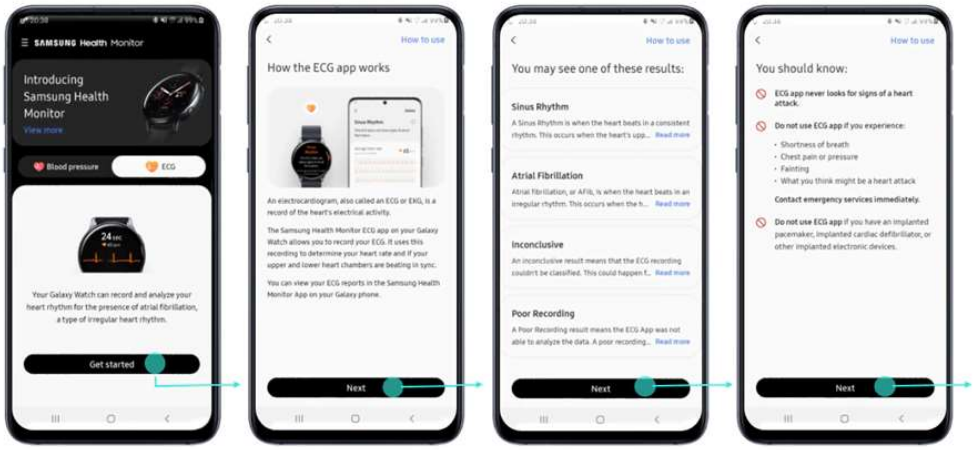

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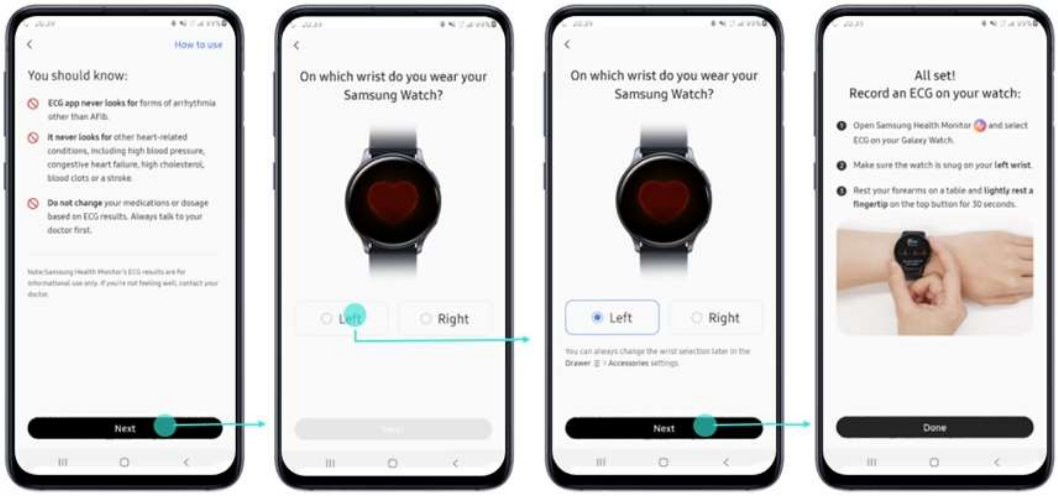
Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : **<Measure>**

4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

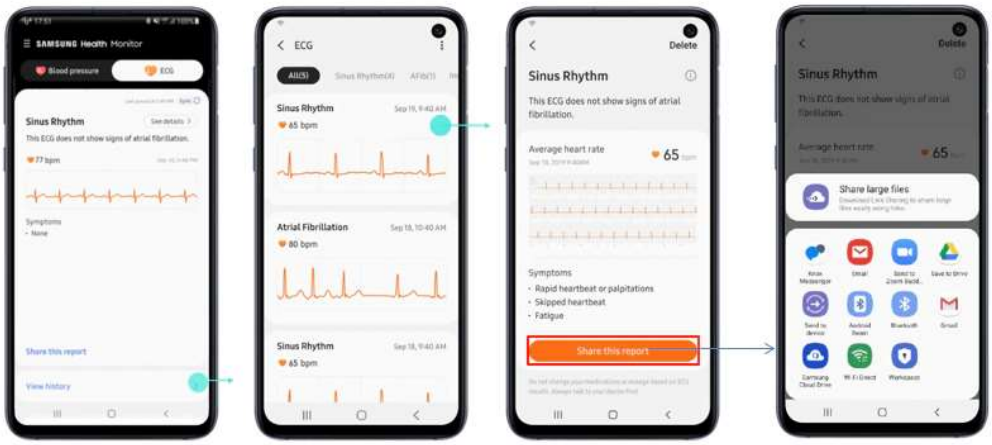
A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.

A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



240. On information and belief, Defendants had knowledge of Plaintiffs' algorithm and apparatus as claimed through their previous work together, and through Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

241. Defendants' infringement of the '652 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data of working with Dr. Chon, coupled with public disclosure of Plaintiffs' algorithm and apparatus, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

242. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as their communications with him through the years of 2015-2018. Defendants either knew or

took active steps to avoid learning of the '652 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

243. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

244. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

245. The '652 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

246. In addition to the innovations set forth, the '652 patent overcame the limitation of inaccurate estimations of heart rates from ECG signals during intense physical activity and instead, an algorithm is used to employ a time-varying spectral analysis approach for reconstructing an ECG signal that includes motion artifacts to accurately detect heart rates.

247. For the reasons set forth, the '652 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 5.

248. Because of Defendants' infringement of the '652 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

249. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '652 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '652 patent and active inducement of infringement of the '652 patent.

250. Samsung has infringed and continues to infringe the '652 patent by making, using, selling, offering to sell, and/or importing, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '652 patent literally or under the doctrine of equivalents.

251. Samsung has induced infringement and continues to induce infringement of the '652 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '652 patent literally or under the doctrine of equivalents.

252. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make,

use, sell, offer to sell and/or import the Accused Watches. For example, Samsung, or an entity under Samsung's direction or control, advertises, offers for sale, and/or otherwise promotes the Accused Watches on its website. Samsung, or one or more related entities, induces retailers and end users. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '652 patent, as described and alleged herein.

253. Plaintiffs reserve the right to assert additional claims of the '652 patent that Defendants infringe.

254. On information and belief, Samsung has known of the existence of the '652 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the '652 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count VI: Infringement of United States Patent No. 9,986,921 by Samsung

255. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

256. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '921 patent under at least 35 U.S.C. §271.

257. On information and belief, Defendants have directly infringed one or more claims of the '921 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

258. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '921 patent, and the above-listed Samsung Watches may infringe additional patents.

259. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

260. For example, Claim 1 covers:

> A computer implemented method for discriminating between normal sinus rhythm without premature ventricular contractions (PVC) or premature atrial contractions (PAC) and atrial fibrillation and premature ventricular contractions (PVC) and premature atrial contractions (PACs), the method comprising:
> obtaining root mean squared of successive differences, Shannon entropy and turning point ratio for peak-to-peak (PPI) interval data;
> comparing the root mean square of successive differences to a first predetermined threshold; comparing the Shannon entropy to a second predetermined threshold;

comparing the turning point ratio to a third predetermined threshold; and

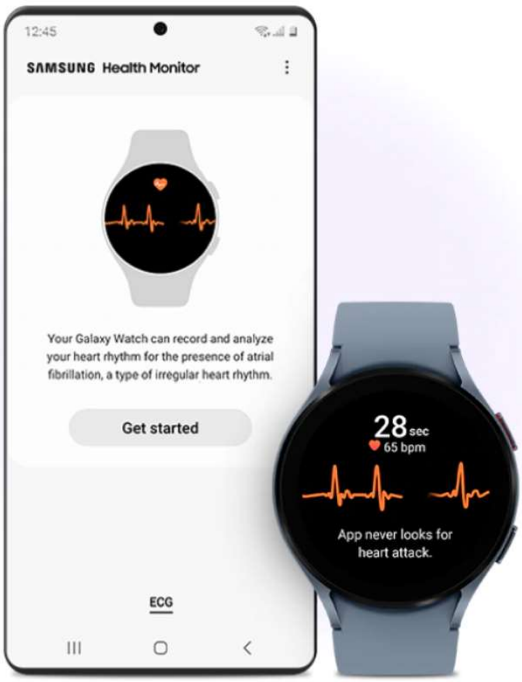
determining, when each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is less than a corresponding predetermined threshold, a subject under test has normal sinus rhythm without PAC or PVC.

261. On information and belief, the algorithm used by the Accused Watches implemented a computer method for discriminating between normal sinus rhythm without premature ventricular contractions (PVC) or premature atrial contractions (PAC) and atrial fibrillation and premature ventricular contractions (PVC) and premature atrial contractions (PACs), including as shown below.

https://www.samsung.com/us/apps/samsung-health-monitor/ ,

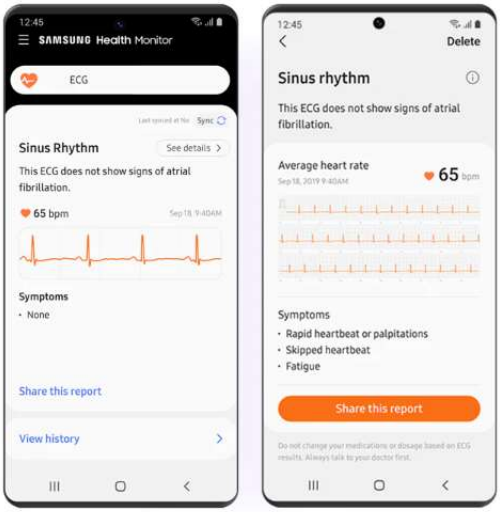
https://developer.samsung.com/health/privileged

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor



Take ECG measurements with Galaxy Watch

The Galaxy Watch takes ECG measurements and checks the results for irregular heartbeats and notifies you accordingly.[1]



❶ ECG report ❷ ECG report specifics

After you take an ECG, the ECG data is synced to the paired Galaxy smartphone where a PDF report is created.

1) Your ECG analysis is sent from Galaxy Watch to your Galaxy smartphone shortly after measurement.

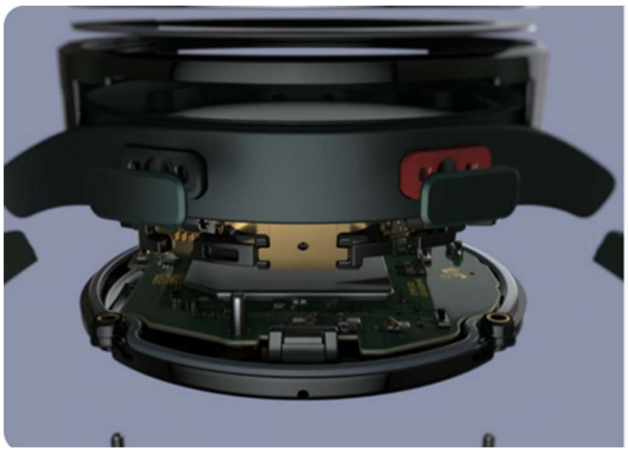
2) On the phone app, you can retrieve detailed results transmitted from your Galaxy Watch and you can see the classified results as follows:

· Sinus Rhythm: A sinus rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync. A sinus rhythm result is based only on that particular ECG recording, and doesn't mean your heart beats uniformly all the time. Also, a sinus rhythm result does not guarantee that you are not experiencing arrhythmia or another health condition. If you are not feeling well regardless of your result, contact your doctor.

· Atrial Fibrillation: Atrial Fibrillation, or AFib, is when the heart beats in an irregular rhythm. This occurs when the heart's upper chambers beat out of sync with the lower chambers. AFib is the most common form of an irregular heartbeat. If not treated, it can lead to blood clots, stroke, heart failure, and other health problems.

· Inconclusive: An inconclusive result means that the ECG recording could not be classified. This could happen if:
- The heart rate during the recording was less than 50 bpm.
- The heart rate during recording was greater than 100 bpm and the rhythm was not AFib.
- The heart rhythm was AFib and the heart rate was greater than 120 bpm. The heart rhythm was neither sinus rhythm nor AFib.
If you get this result repeatedly, contact your doctor.

· Poor recording: A poor recording result means Samsung Health Monitor was not able to analyze the data. A poor recording usually happens because your body moved during recording, or the Galaxy Watch didn't have enough skin contact with your wrist or finger. If you get this result repeatedly, see the Troubleshooting section in the Instructions For Use document.



Leveraging Galaxy Watch's Advanced...

As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...

262. On information and belief, the algorithm used by the Accused Watches obtains root mean squared of successive differences, Shannon entropy and turning point ratio for peak-to-peak (PPI) interval data.

263. On information and belief, the algorithm used by the Accused Watches compares the root mean square of successive differences to a first predetermined threshold, compares the Shannon entropy to a second predetermined threshold,

compares the turning point ratio to a third predetermined threshold, and determines when each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is less than a corresponding predetermined threshold, a subject under test has normal sinus rhythm without PAC or PVC.

264. On information and belief, the Accused Watches utilize Plaintiffs' algorithm capable of real-time arrhythmia discrimination, which can discriminate between NSR, AF, PACs and PVCs using pulsatile time series. This capability is shown in the images below found on the Samsung website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

265. On information and belief, Defendants had knowledge of Plaintiffs' algorithm as claimed in Claim 1 through their previous work together, and through

Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

266. Defendants' infringement of the '921 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data of working with Dr. Chon, coupled with public disclosure of Plaintiffs' algorithm, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

267. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as their communications with him through the years of 2015-2018. Defendants either knew or took active steps to avoid learning of the '921 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

268. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch

will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

269. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose,

without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

270. The '921 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

271. In addition to the innovations set forth, the '921 patent overcame the limitation of inaccurate detection of AF in the presence of many PAC/PVC episodes interspersed with NSR because the presence of many PAC/PVC episodes interspersed with NSR can mimic the random dynamics of the AF. Instead, an enhanced real-time realizable AF algorithm is used for accurate detection of, and discrimination between, NSR, AF, PVC, and PAC.

272. For the reasons set forth, the '921 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 6.

273. Because of Defendants' infringement of the '921 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

274. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '921 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '921 patent and active inducement of infringement of the '921 patent.

275. Samsung has infringed and continues to infringe the '921 patent by making, using, selling, offering to sell, and/or importing, without license or authority,

the Accused Watches as alleged herein, which embody or use the inventions claimed in the '921 patent literally or under the doctrine of equivalents.

276. Samsung has induced infringement and continues to induce infringement of the '921 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '921 patent literally or under the doctrine of equivalents.

277. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make, use, sell, offer to sell and/or import the Accused Watches. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '921 patent, as described and alleged herein.

278. Plaintiffs reserve the right to assert additional claims of the '921 patent that Defendants infringe.

279. On information and belief, Samsung has known of the existence of the '921 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the '921 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count VII: Infringement of United States Patent No. 10,278,647 by Samsung

280. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

281. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '647 patent under at least 35 U.S.C. § 271.

282. On information and belief, Defendants have directly infringed one or more claims of the '647 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

283. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '647 patent, and the above-listed Samsung Watches may infringe additional patents.

284. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

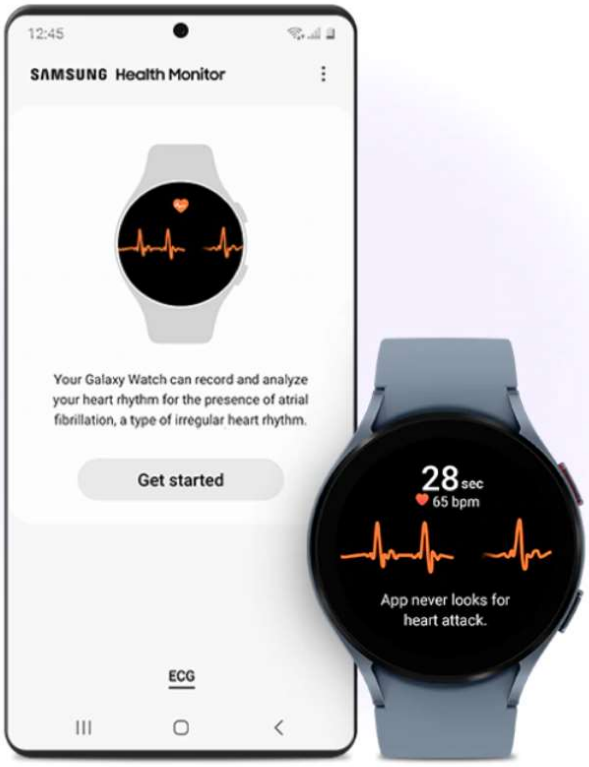
285. For example, Claim 1 covers:

> A method for reconstructing a heart-related signal output by a biomedical sensor, the method comprising:
>
> reconstructing a representation of the heart-related signal to produce a reconstructed representation of the heart-related signal, the reconstructing based on (i) a time-varying spectral analysis of the heart-related signal and a motion signal, the motion signal output by a motion sensor and representative of motion artifacts in the heart-related signal, the motion artifacts being signal artifacts produced by movement of the biomedical sensor relative to a sensing location, and (ii) a classification of the movement, wherein the time-varying spectral analysis includes pre-processing the heart-related signal to produce a pre-processed heart-related signal, pre-processing the motion signal to produce a pre-processed motion signal, and computing a first time-frequency spectrum (TFS) of the heart-related signal using the pre-processed heart-related signal and a second TFS of the motion signal using the pre-processed motion signal; and
>
> outputting the reconstructed representation of the heart-related signal.

286. On information and belief, the algorithm used by the Accused Watches reconstructs a heart-related signal output by a biomedical sensor, including as shown below. https://www.samsung.com/us/apps/samsung-health-monitor/ ,

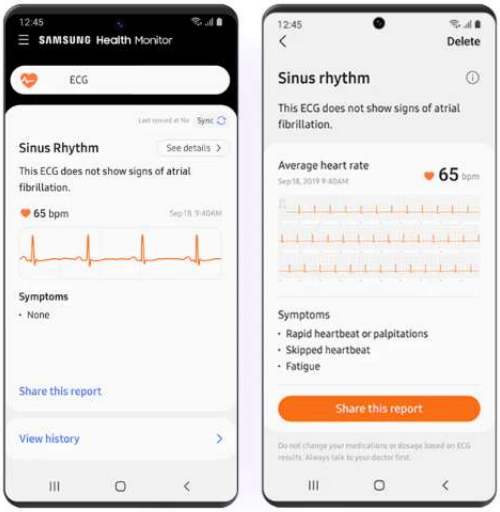
https://developer.samsung.com/health/privileged ,

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor



Take ECG measurements with Galaxy Watch

The Galaxy Watch takes ECG measurements and checks the results for irregular heartbeats and notifies you accordingly.[1]



❶ ECG report ❷ ECG report specifics

After you take an ECG, the ECG data is synced to the paired Galaxy smartphone where a PDF report is created.

1) Your ECG analysis is sent from Galaxy Watch to your Galaxy smartphone shortly after measurement.

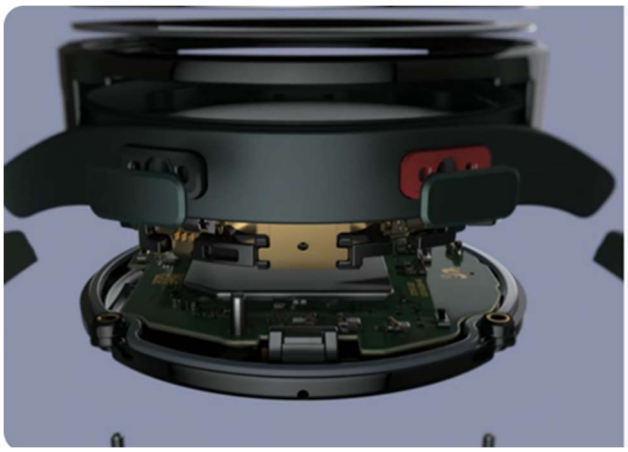
2) On the phone app, you can retrieve detailed results transmitted from your Galaxy Watch and you can see the classified results as follows:

· Sinus Rhythm: A sinus rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync. A sinus rhythm result is based only on that particular ECG recording, and doesn't mean your heart beats uniformly all the time. Also, a sinus rhythm result does not guarantee that you are not experiencing arrhythmia or another health condition. If you are not feeling well regardless of your result, contact your doctor.

· Atrial Fibrillation: Atrial Fibrillation, or AFib, is when the heart beats in an irregular rhythm. This occurs when the heart's upper chambers beat out of sync with the lower chambers. AFib is the most common form of an irregular heartbeat. If not treated, it can lead to blood clots, stroke, heart failure, and other health problems.

· Inconclusive: An inconclusive result means that the ECG recording could not be classified. This could happen if:
- The heart rate during the recording was less than 50 bpm.
- The heart rate during recording was greater than 100 bpm and the rhythm was not AFib.
- The heart rhythm was AFib and the heart rate was greater than 120 bpm. The heart rhythm was neither sinus rhythm nor AFib.
If you get this result repeatedly, contact your doctor.

· Poor recording: A poor recording result means Samsung Health Monitor was not able to analyze the data. A poor recording usually happens because your body moved during recording, or the Galaxy Watch didn't have enough skin contact with your wrist or finger. If you get this result repeatedly, see the Troubleshooting section in the Instructions For Use document.



Leveraging Galaxy Watch's Advanced...

As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...

287. On information and belief, the algorithm used by the Accused Watches reconstructs a representation of the heart-related signal to produce a reconstructed representation of the heart-related signal, the reconstructing based on (i) a time-varying spectral analysis of the heart-related signal and a motion signal, the motion signal output by a motion sensor and representative of motion artifacts in the heart-related signal, the motion artifacts being signal artifacts produced by movement of the

biomedical sensor relative to a sensing location, and (ii) a classification of the movement, wherein the time-varying spectral analysis includes pre-processing the heart-related signal to produce a pre-processed heart-related signal, pre-processing the motion signal to produce a pre-processed motion signal, and computing a first time-frequency spectrum (TFS) of the heart-related signal using the pre-processed heart-related signal and a second TFS of the motion signal using the pre-processed motion signal, including as shown below.

https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/ ,

https://www.samsung.com/us/support/troubleshooting/TSG01203537/ ,

https://www.samsung.com/us/support/troubleshooting/TSG01208783 /

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

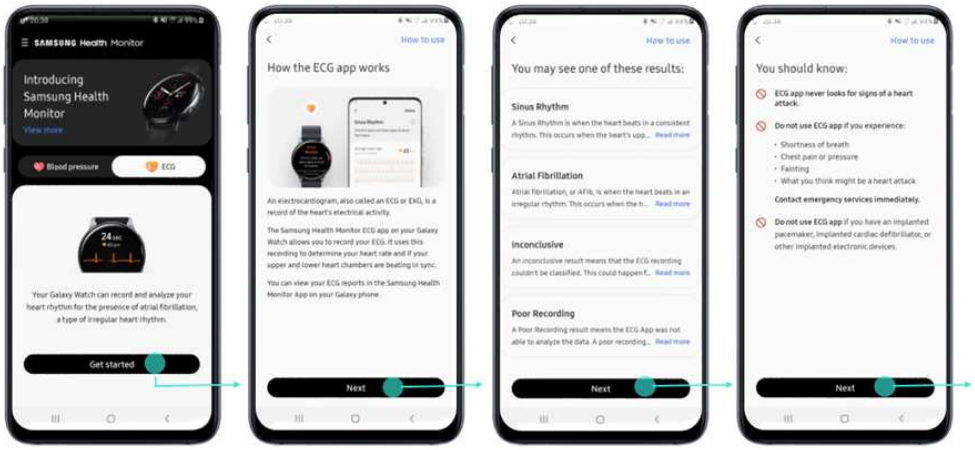
A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

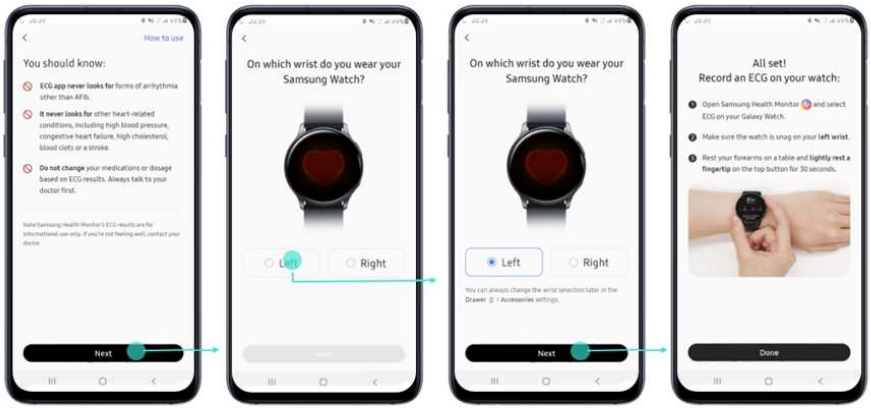
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : **<Measure>**

4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

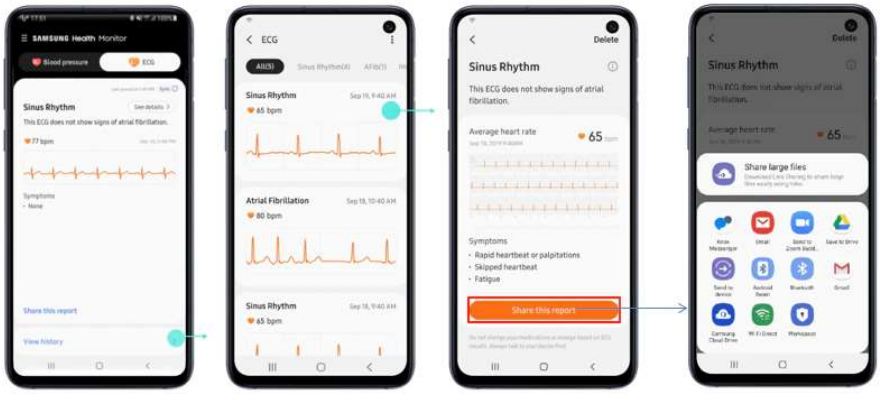
A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.

A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



Samsung smart watch detects unnecessary movements as exercise

When Workout detection is turned on, your Samsung smart watch will automatically detect and record activities you perform like walking, running, and cycling. However, if you're performing other actions or movements, like driving, the watch may think you're performing a workout. You can easily turn off this feature to avoid unnecessary movement being detected as a workout.

SAMSUNG Mobile TV & Audio Appliances Computing Displays Accessories SmartThings Offers Outlet ↗ Explore Support For Business

Home / Inaccurate or no ECG results in Samsung Health Monitor

Inaccurate or no ECG results in Samsung Health Monitor

If you can't record your ECG when using the Samsung Health Monitor app, can't see your ECG results, or are receiving poor or inconclusive results, there are a few things you can check. These include checking the Bluetooth connection between your Galaxy watch and phone, making sure you're wearing your watch correctly, and cleaning your hands and arms before recording.

I cannot record my ECG

During the recording process, check for the following:

- Your fingertip is fully covering the top button.
- You do not move your arms or talk.
- You do not press the top button, only cover it with your finger.
- Your finger is resting lightly on the top button for the 30 seconds it takes to complete the recording.

I am repeatedly getting a Poor recording result

A poor recording result means that the Samsung Health Monitor app was not able to analyze your data. You may receive a poor recording if you moved your body during a recording or if your watch did not have enough skin contact with your wrist or finger. There are a few things you can try in order to receive a proper recording.

- Clean your hand, wrist, and the back of the watch.
- Moisturize your hand and wrist with lotion.
- If your skin is cold, remove the watch and gently rub your wrist to warm up your skin. Then, put the watch back on and try recording again.
- Make sure the watch is snug on your wrist and then rest your forearms comfortably on a table or flat surface when taking the ECG.
- For better skin contact, try wearing the watch slightly away from your wrist bone and toward your elbow.

Certain physiological conditions can prevent some people from having a strong signal. This can deter the Samsung Health Monitor app from detecting and analyzing their readings.

288. On information and belief, the algorithm used by the Accused Watches outputs the reconstructed representation of the heart-related signal, including as shown

below. https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/

Q : How do I measure the ECG on Galaxy Watch device?

A : An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity.

The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

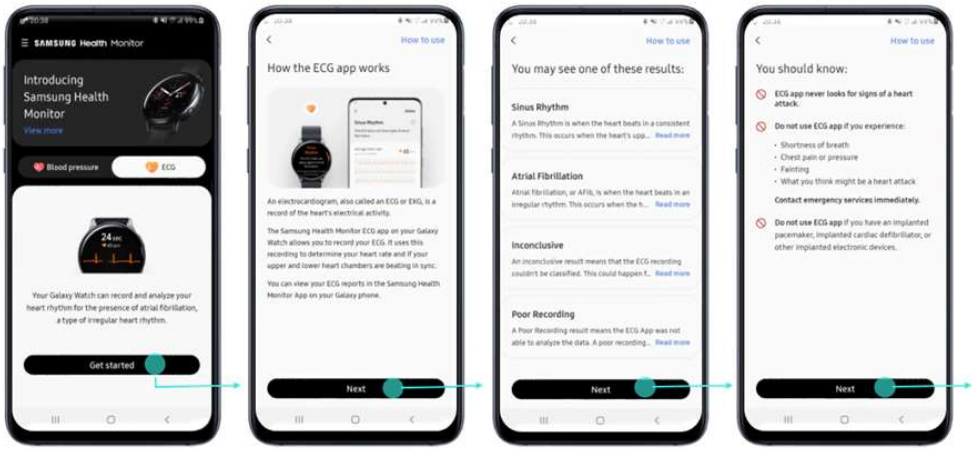
A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

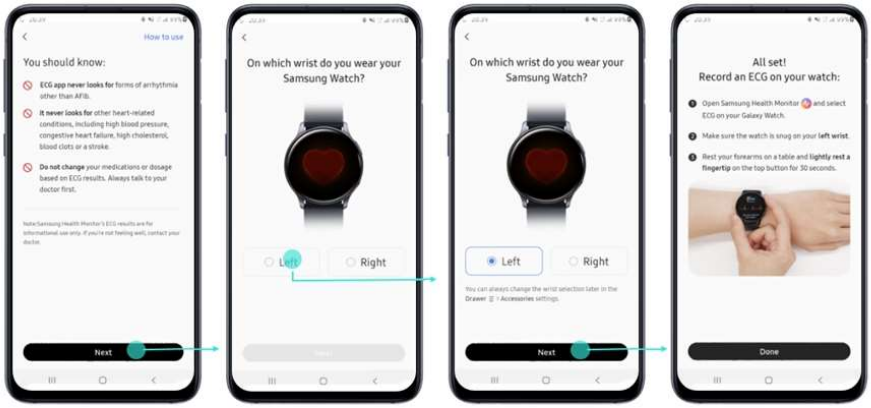
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : <Measure>

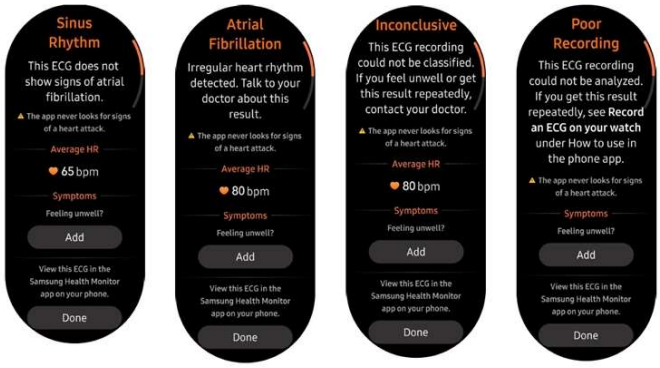
4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

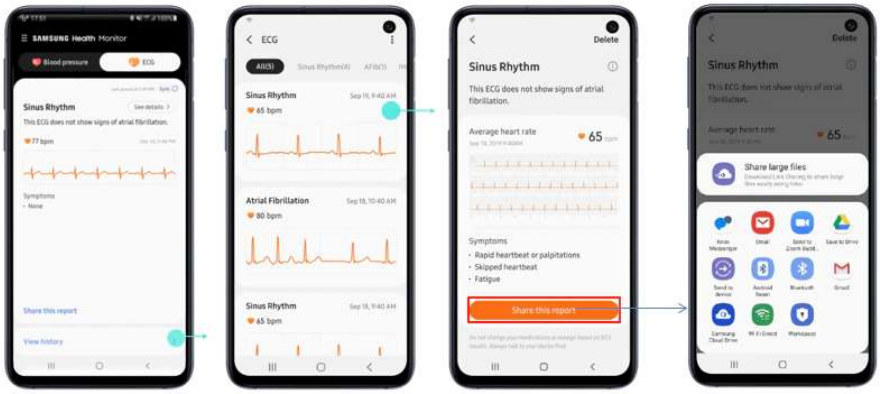
Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.



A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



289. On information and belief, the Accused Watches utilize Plaintiffs' algorithm and method claims to employ a time-varying spectral approach for reconstructing a heart-related signal that includes motion artifacts using at least of a PPG sensor, piezoelectric sensor, LED based sensor, camera sensor, and a pulse oximeter sensor.

290. On information and belief, the method and apparatus for heart-related signal monitoring that includes motion artifacts is shown in the images below found on the Samsung website at: https://developer.samsung.com/health/privileged ,

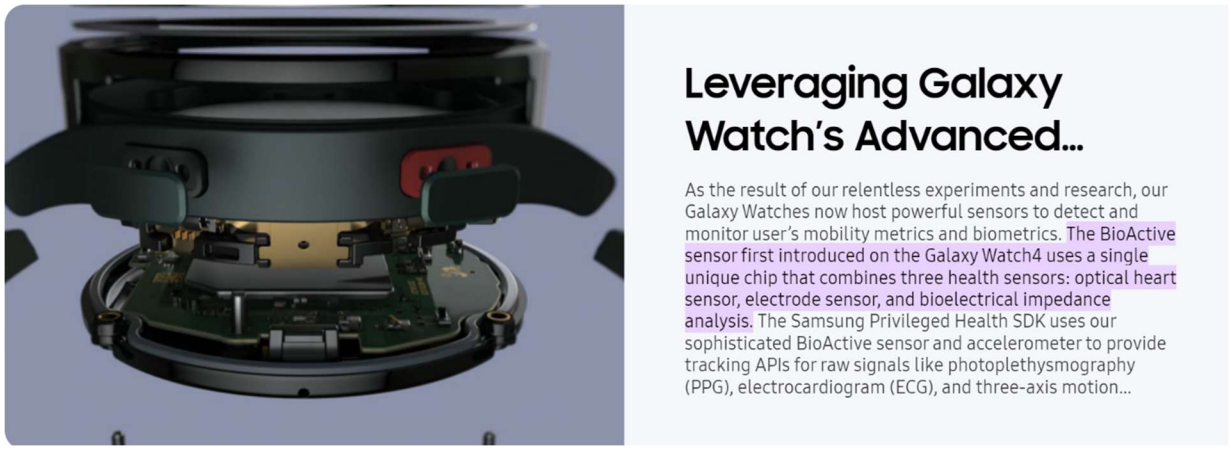
https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor ,

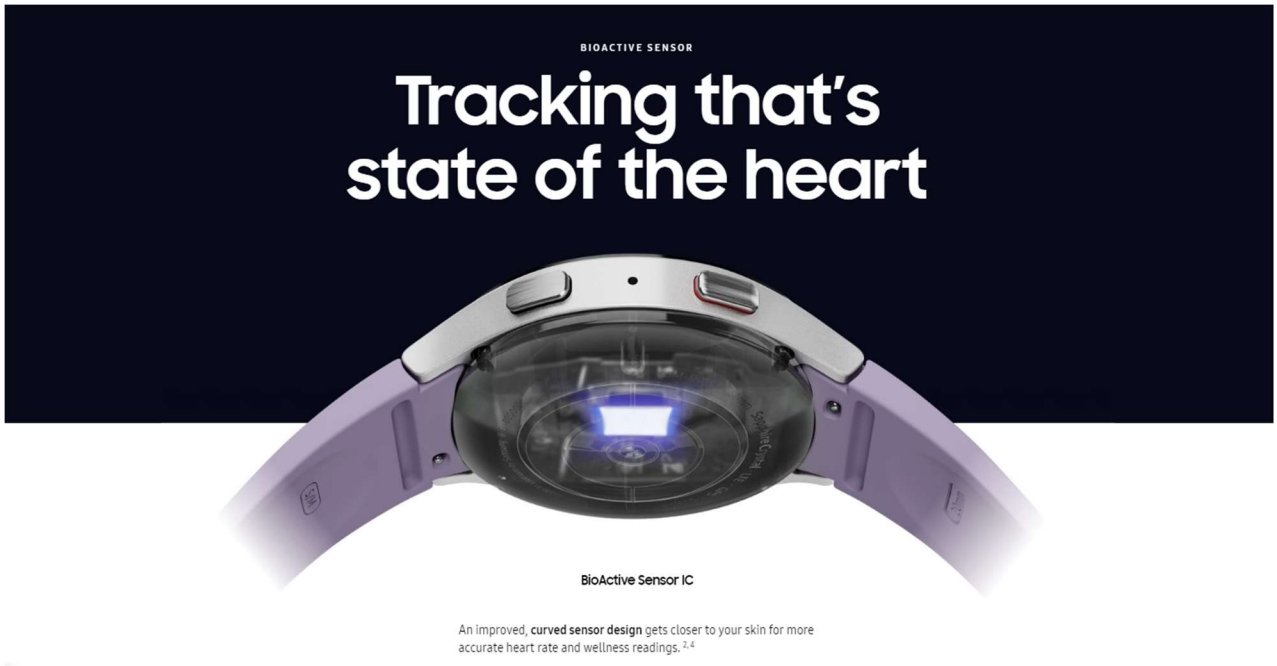
https://www.samsung.com/us/support/troubleshooting/TSG01203537/ ,

https://www.samsung.com/us/apps/samsung-health-monitor/ ,

https://www.samsung.com/sg/support/mobile-devices/how-to-measure-ecg-with-the-galaxy-watch/ , https://www.samsung.com/us/watches/ ,

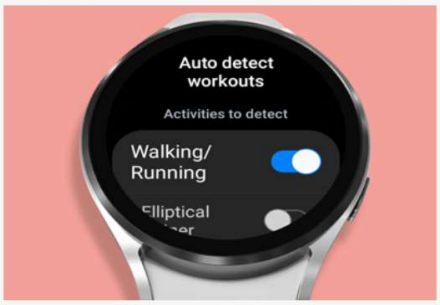
https://www.samsung.com/africa_en/support/mobile-devices/how-do-i-measure-the-ecg-on-galaxy-watch-device/





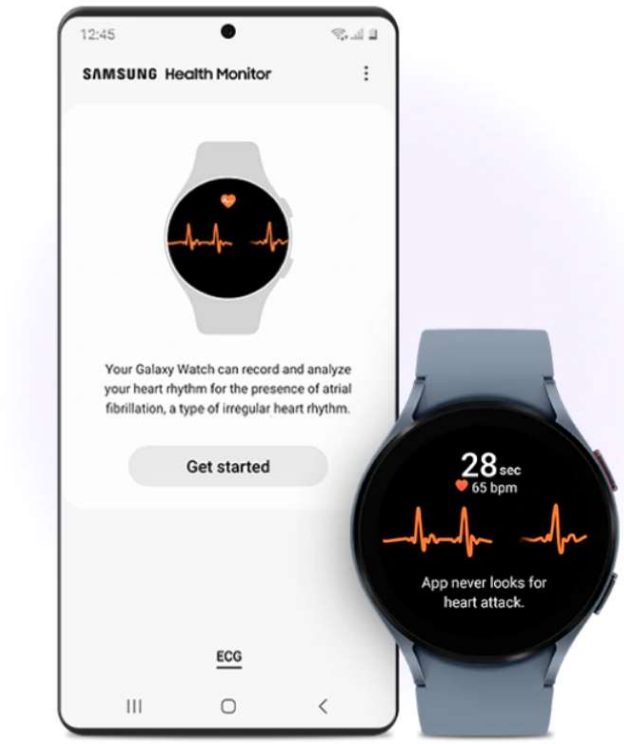
Optical Heart Rate Sensor

Monitor your heart rate during workouts and as you recover. With heart rate sensors and more, you can optimize your performance to reach new goals. [2]



Samsung smart watch detects unnecessary movements as exercise

When Workout detection is turned on, your Samsung smart watch will automatically detect and record activities you perform like walking, running, and cycling. However, if you're performing other actions or movements, like driving, the watch may think you're performing a workout. You can easily turn off this feature to avoid unnecessary movement being detected as a workout.



How to Measure ECG with Galaxy Watch Active2 and Watch3

Last Update date : Jul 22. 2022

The Samsung Galaxy Watch Active2/Galaxy Watch3 can be used to take Electrocardiogram (ECG) readings. Find out how you can first set it up using your Galaxy smartphone and measure subsequent readings with your watch.

Before you try out the recommendations below, be sure to check that your watch and phone's software and related apps are updated to the latest versions.

What is the ECG app for?

An Electrocardiogram – also called an ECG or EKG – is a record of the heart's electrical activity. The ECG App uses your Galaxy watch to record and analyze your heart rhythm for the presence of Atrial Fibrillation, a type of irregular heart rhythm. It uses this recording to determine your heart rate and if your upper and lower heart chambers are beating in sync. You can view your ECG reports in the Samsung Health Monitor App on your Galaxy phone.

Favorite Galaxy Watch features

01 **Auto workout tracking**

02 **Battery life**

03 **Durability**

04 **Body Composition analysis**

05 **Seamless connectivity**

Sync to your Galaxy mobile devices to stay connected on excursions.[8]

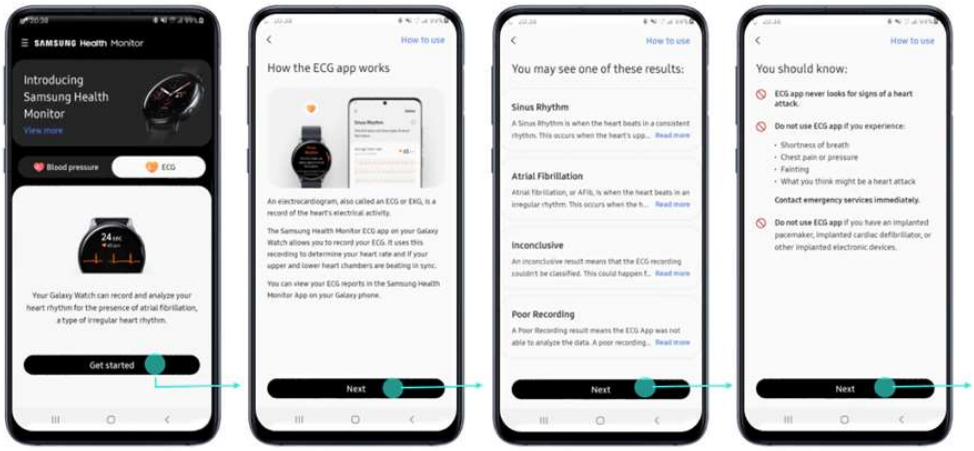
A:

2. Discover the **'Samsung Health Monitor'** feature from pre-installed app on watch face and watch widget.

Phone app is also required to enable the feature. For this, it's required to download the **'Samsung Health Monitor'** application from Google Play Store or Galaxy Store.

A :

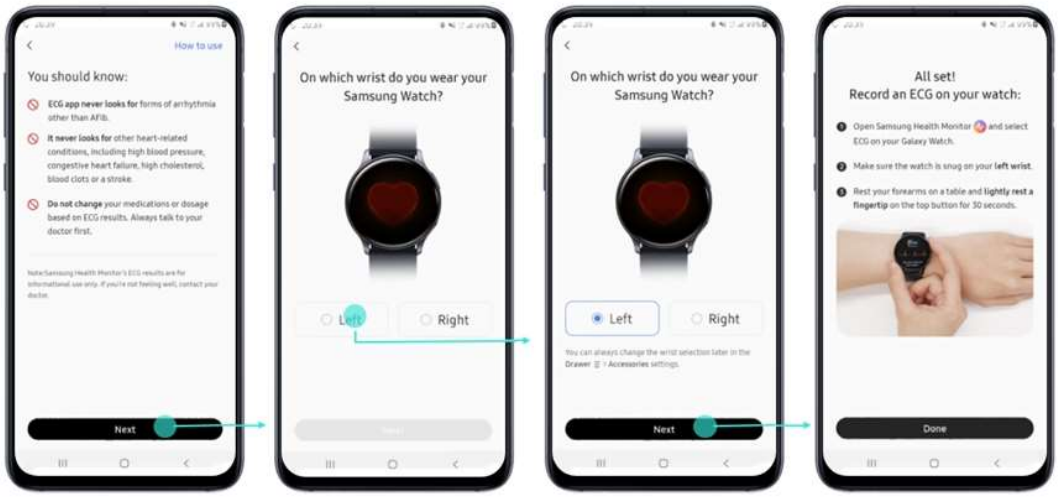
3. Understand the results, cautious and instructions before using.



A :

Wear your Samsung Watch on wrist and make sure the watch is snug on your wrist. You can always change the wrist selection later in the settings.

Open the ECG Monitor app on your Galaxy watch. And, rest your forearms on a table and lightly rest a fingertip on the top button for 30 seconds.



A : **<Measure>**

4. Take on-demand ECG measurement on a calibrated watch.

A : 5. Various different ECG results may occur.

A Sinus Rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync.

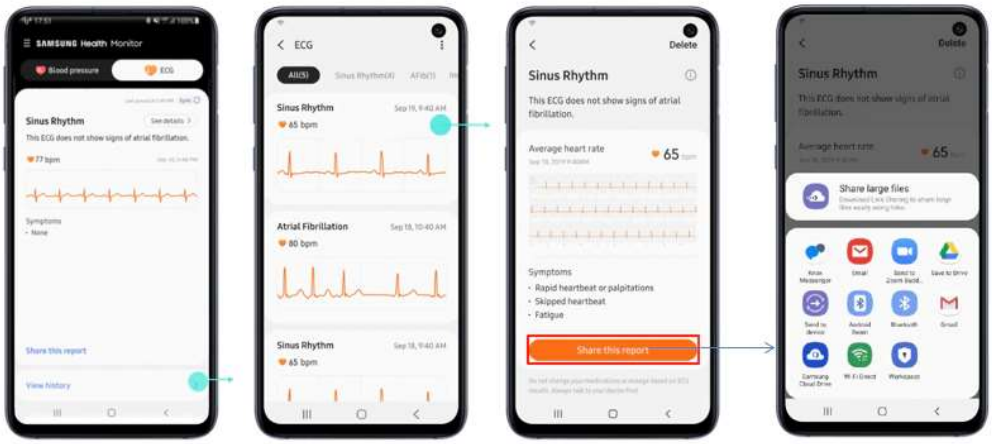
A Sinus Rhythm result is based only on that particular ECG recording and doesn't mean your heart beats uniformly all the time.

Atrial Fibrillation, or Afib, is when the heart beats in an irregular rhythm.

A : 6. After measuring, you can add symptoms to the results. Each measurement result will be transferred to phone app automatically if your watch and mobile device are connected through Bluetooth.

Through Samsung Health Monitor, you can store and manage measurement result, and review the detailed result on phone.

Also you can share the ECG PDF view of the result with others.



291. On information and belief, Defendants had knowledge of Plaintiffs' algorithm and as claimed in Claim 1 through their previous work together, and through Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

292. Defendants' infringement of the '647 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data of working with

Dr. Chon, coupled with public disclosure of Plaintiffs' algorithm and apparatus, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

293. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as through their communications with him through the years of 2015-2018. Defendants either knew or took active steps to avoid learning of the '647 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

294. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and

REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

295. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

296. The '647 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

297. In addition to the innovations set forth, the '647 patent overcame the limitation of inaccurate estimation of a heart rate and changing arterial oxygen saturation from a heart-related signal, such as a PPG signal during intense physical activity resulting in inaccurate heart rate and oxygen rate estimation due to motion artifacts from strenuous and high intensity exercise and instead, a method and corresponding apparatus is used to employ a time-varying spectral analysis approach for reconstructing a heart-related signal that includes motion artifacts.

298. For the reasons set forth, the '647 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 7.

299. Because of Defendants' infringement of the '647 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

300. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '647 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '647 patent and active inducement of infringement of the '647 patent.

301. Samsung has infringed and continues to infringe the '647 patent by making, using, selling, offering to sell, and/or importing, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '647 patent literally or under the doctrine of equivalents.

302. Samsung has induced infringement and continues to induce infringement of the '647 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '647 patent literally or under the doctrine of equivalents.

303. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make, use, sell, offer to sell and/or import the Accused Watches. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '647 patent, as described and alleged herein.

304. Plaintiffs reserve the right to assert additional claims of the '647 patent that Defendants infringe.

305. On information and belief, Samsung has known of the existence of the '647 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the

'647 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count VIII: Infringement of United States Patent No. 10,285,601 by Samsung

306. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth herein.

307. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '601 patent under at least 35 U.S.C. § 271.

308. On information and belief, Defendants have directly infringed one or more claims of the '601 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

309. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '601 patent, and the above-listed Samsung Watches may infringe additional patents.

310. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

311. For example, Claim 1 covers:

> A system for discriminating between normal sinus rhythm without premature ventricular contractions or premature atrial contractions and

atrial fibrillation and premature ventricular contractions (PVC) and premature atrial contractions (PACs), the system comprising:

one or more processors; the one or more processors being configured to:

obtain root mean squared of successive differences, Shannon entropy and turning point ratio for peak-to-peak (PPI) interval data;

compare the root mean square of successive differences to a first predetermined threshold;

compare the Shannon entropy to a second predetermined threshold;

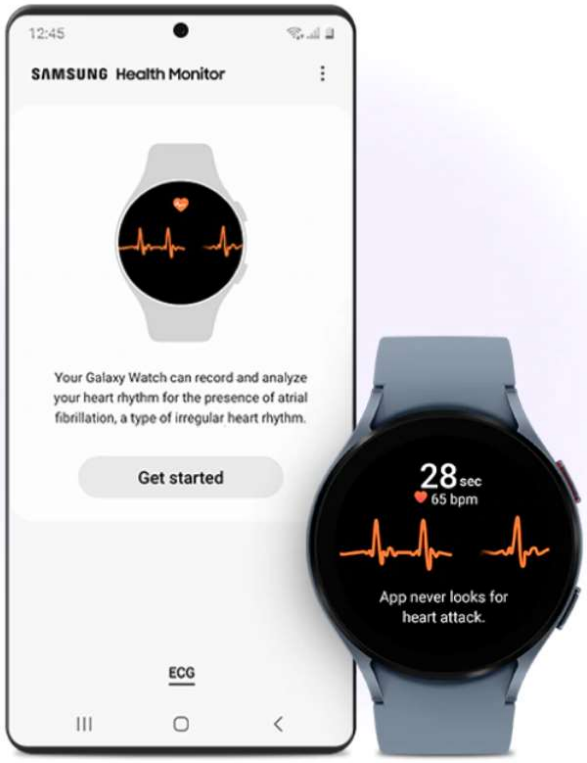
compare the turning point ratio to a third predetermined threshold; and

determine, when each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is less than a corresponding predetermined threshold, a subject under test has normal sinus rhythm without PAC or PVC.

312. On information and belief, the algorithm used by the Accused Watches discriminates between normal sinus rhythm without premature ventricular contractions or premature atrial contractions and atrial fibrillation and premature ventricular contractions (PVC) and premature atrial contractions (PACs), including as shown below. https://www.samsung.com/us/apps/samsung-health-monitor / ,

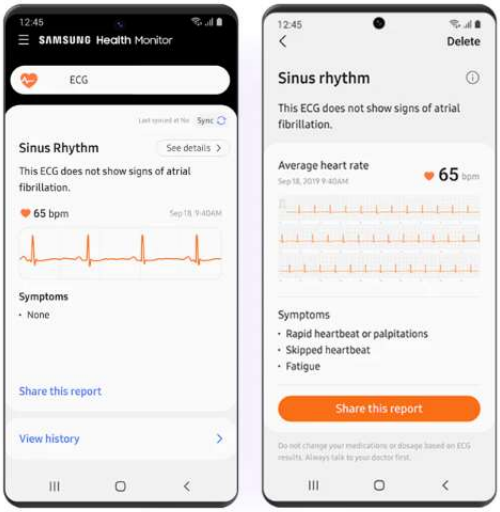
https://developer.samsung.com/health/privileged ,

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor



Take ECG measurements with Galaxy Watch

The Galaxy Watch takes ECG measurements and checks the results for irregular heartbeats and notifies you accordingly.[1]



❶ ECG report ❷ ECG report specifics

After you take an ECG, the ECG data is synced to the paired Galaxy smartphone where a PDF report is created.

1) Your ECG analysis is sent from Galaxy Watch to your Galaxy smartphone shortly after measurement.

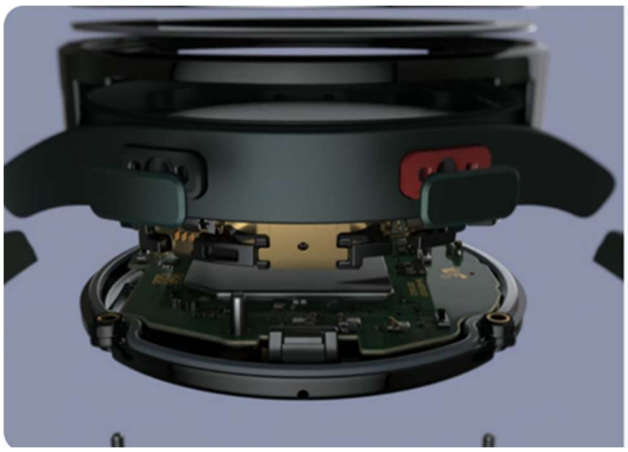
2) On the phone app, you can retrieve detailed results transmitted from your Galaxy Watch and you can see the classified results as follows:

· Sinus Rhythm: A sinus rhythm is when the heart beats in a consistent rhythm. This occurs when the heart's upper and lower chambers beat in sync. A sinus rhythm result is based only on that particular ECG recording, and doesn't mean your heart beats uniformly all the time. Also, a sinus rhythm result does not guarantee that you are not experiencing arrhythmia or another health condition. If you are not feeling well regardless of your result, contact your doctor.

· Atrial Fibrillation: Atrial Fibrillation, or AFib, is when the heart beats in an irregular rhythm. This occurs when the heart's upper chambers beat out of sync with the lower chambers. AFib is the most common form of an irregular heartbeat. If not treated, it can lead to blood clots, stroke, heart failure, and other health problems.

· Inconclusive: An inconclusive result means that the ECG recording could not be classified. This could happen if:
- The heart rate during the recording was less than 50 bpm.
- The heart rate during recording was greater than 100 bpm and the rhythm was not AFib.
- The heart rhythm was AFib and the heart rate was greater than 120 bpm. The heart rhythm was neither sinus rhythm nor AFib.
If you get this result repeatedly, contact your doctor.

· Poor recording: A poor recording result means Samsung Health Monitor was not able to analyze the data. A poor recording usually happens because your body moved during recording, or the Galaxy Watch didn't have enough skin contact with your wrist or finger. If you get this result repeatedly, see the Troubleshooting section in the Instructions For Use document.

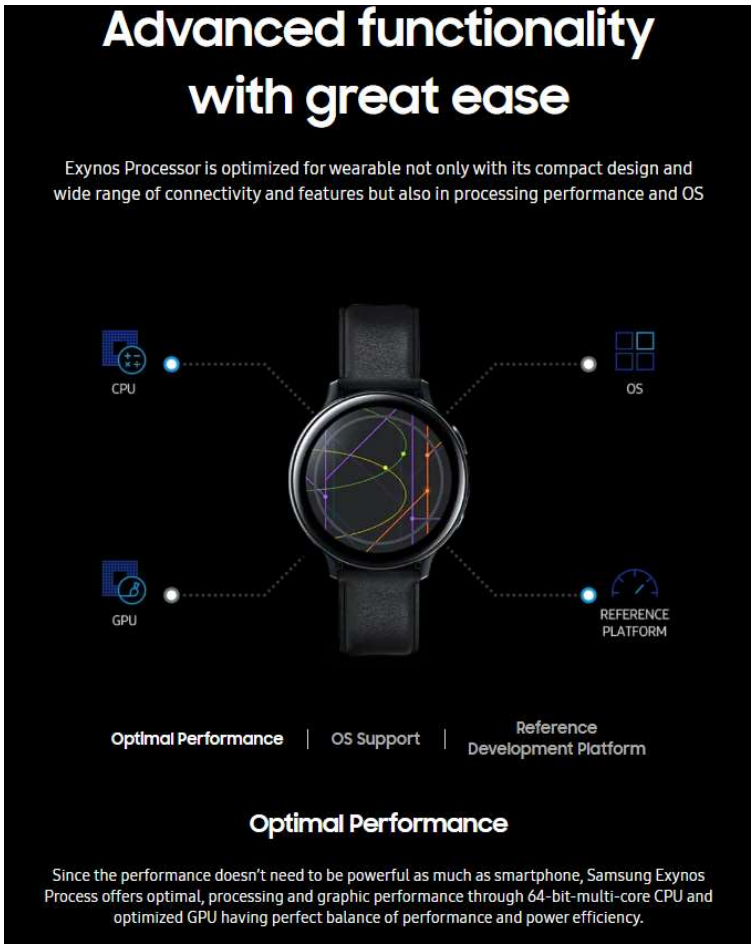


Leveraging Galaxy Watch's Advanced...

As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...

313. The algorithm and technology used by the Accused Watches have one or more processors, including as shown below.

https://semiconductor.samsung.com/processor/wearable-processor/smartwatch/



314. On information and belief, the algorithm used by the Accused Watches obtains root mean squared of successive differences, Shannon entropy and turning point ratio for peak-to-peak (PPI) interval data.

315. On information and belief, the algorithm used by the Accused Watches compares the root mean square of successive differences to a first predetermined threshold.

316. On information and belief, the algorithm used by the Accused Watches compares the Shannon entropy to a second predetermined threshold.

317. On information and belief, the algorithm used by the Accused Watches compares the turning point ratio to a third predetermined threshold.

318. On information and belief, the algorithm used by the Accused Watches determines, when each of the root mean square of successive differences, the Shannon entropy, and the turning point ratio is less than a corresponding predetermined threshold, a subject under test has normal sinus rhythm without PAC or PVC.

319. On information and belief, the Accused Watches utilize Plaintiffs' algorithm capable of real-time arrhythmia discrimination, which can discriminate between NSR, AF, PACs and PVCs using pulsatile time series. This capability is shown in the images below found on the Samsung website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

320. On information and belief, Defendants had knowledge of Plaintiffs' algorithm and system as claimed in Claim 1 through their previous work together, and through Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

321. Defendants' infringement of the '601 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data of working with Dr. Chon, coupled with public disclosure of Plaintiffs' algorithm, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

322. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as through their communications with him through the years of 2015-2018. Defendants either knew or took active steps to avoid learning of the '601 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

323. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open

up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

324. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was discussed numerous times throughout their working relationship, Defendants chose

instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

325. The '601 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

326. In addition to the innovations set forth, the '601 patent overcame the limitation of inaccurate detection of AF in the presence of many PAC/PVC episodes interspersed with NSR because the presence of many PAC/PVC episodes interspersed with NSR can mimic the random dynamics of AF and instead, a real-time realizable AF algorithm is used for accurate detection of, and discrimination between NSR, AF, PVC, and PAC.

327. For the reasons set forth, the '601 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 8.

328. Because of Defendants' infringement of the '601 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

329. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '601 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '601 patent and active inducement of infringement of the '601 patent.

330. Samsung has infringed and continues to infringe the '601 patent by making, using, selling, offering to sell, and/or importing, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '601 patent literally or under the doctrine of equivalents.

331. Samsung has induced infringement and continues to induce infringement of the '601 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '601 patent literally or under the doctrine of equivalents.

332. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make, use, sell, offer to sell and/or import the Accused Watches. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '601 patent, as described and alleged herein.

333. Plaintiffs reserve the right to assert additional claims of the '601 patent that Defendants infringe.

334. On information and belief, Samsung has known of the existence of the '601 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the '601 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

Count IX: Infringement of United States Patent No. 10,653,362 by Samsung

335. Plaintiffs incorporate each of the preceding paragraphs as if fully set forth here.

336. On information and belief, Defendants' products, including at least the Accused Watches, infringe at least Claim 1 of the '362 patent under at least 35 U.S.C. § 271.

337. On information and belief, Defendants have directly infringed one or more claims of the '362 patent through the manufacture, use, sale, offer for sale, and/or importation into the United States of physiological monitors, including at least the Accused Watches.

338. The above-listed Samsung Watches are non-limiting. Additional products of Samsung may infringe the '362 patent, and the above-listed Samsung Watches may infringe additional patents.

339. On information and belief, at least the Accused Watches listed above are sold with the Samsung Health Monitor app and infringing technology/algorithms.

340. For example, Claim 1 covers:

> A computer implemented method for physiological parameter monitoring using a signal used as a Photoplethysmogram (PPG) signal, the computer implemented method comprising:
>
> obtaining a time frequency spectrum of a segment of the signal used as the PPG signal;
>
> obtaining, from the time frequency spectrum, a noise quality index for the segment; the noise quality index being used to determine whether the segment is corrupted by motion and noise artifacts;
>
> wherein obtaining a noise quality index comprises:
>
> determining a dominant frequency in the time frequency spectrum of the segment;
>
> normalizing the time frequency spectrum to a total power in a narrow band centered at the dominant frequency;
>
> determining a first trace of amplitudes in the narrow band spectrum of the time frequency spectrum centered at the dominant frequency;
>
> determining a second trace of amplitudes in a narrow band spectrum of the time frequency spectrum centered at twice the dominant frequency;
>
> determining a third trace of amplitudes in a narrow band spectrum of the time frequency spectrum centered at three times the dominant frequency;
>
> subtracting the first, second and third traces of amplitudes from the time frequency spectrum;
>
> obtaining, after subtracting, a total power remaining in the time frequency spectrum, said total power remaining referred to as a residual noise power;
>
> determining a difference in frequency between the first trace and the second and third traces, the difference in frequency referred to as a projected difference;

the noise quality index being a weighted sum of factors including the residual noise power and the projected difference; weights being selected such that each weighted factor represents less than a predetermined percentage of power in an uncorrupted segment;

applying a statistical learning method, using the noise quality index, to determine whether the segment is corrupted by motion and noise artifacts or not corrupted by motion and noise artifacts;

and,

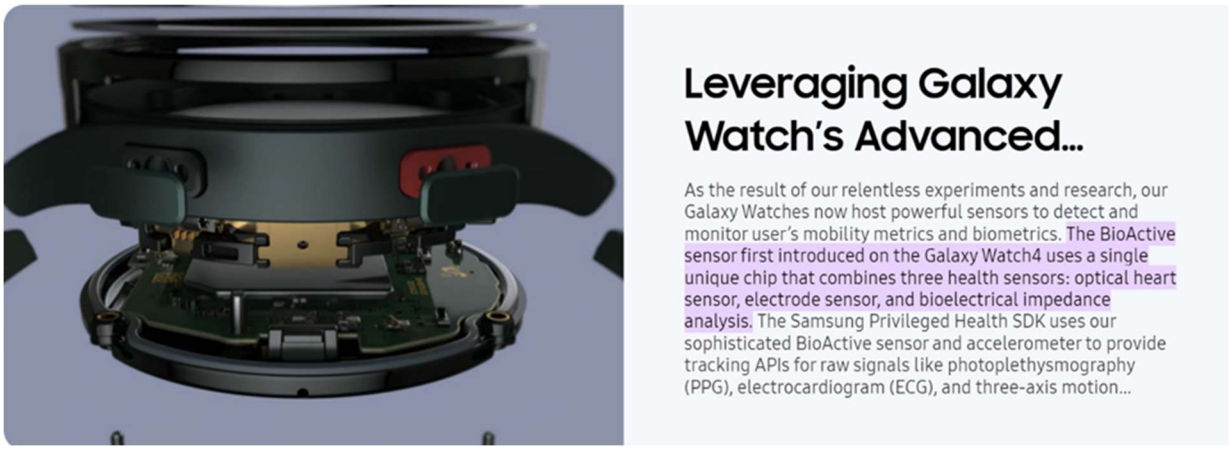
if motion and noise artifacts are not present, including the segment in determination of a physiological parameter.

341. The algorithm used by the Accused Watches implement a computer method for physiological parameter monitoring using a signal used as a Photoplethysmogram (PPG) signal, including as shown below.

https://ss7.vzw.com/is/content/VerizonWireless/samsung-noblesse-galaxy-watch3-ug , https://developer.samsung.com/health/privileged ,

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor


|Getting started
LTE model
Atmospheric pressure sensor
GPS antenna
Light sensor
Speaker
Touchscreen
Back key
Microphone
Home key
Band
Pressure vent
Heart rate sensor


Leveraging Galaxy Watch's Advanced...
As the result of our relentless experiments and research, our Galaxy Watches now host powerful sensors to detect and monitor user's mobility metrics and biometrics. The BioActive sensor first introduced on the Galaxy Watch4 uses a single unique chip that combines three health sensors: optical heart sensor, electrode sensor, and bioelectrical impedance analysis. The Samsung Privileged Health SDK uses our sophisticated BioActive sensor and accelerometer to provide tracking APIs for raw signals like photoplethysmography (PPG), electrocardiogram (ECG), and three-axis motion...

342. On information and belief, the algorithm used by the Accused Watches obtains a time frequency spectrum of a segment of the signal used as the PPG signal.

343. On information and belief, the algorithm used by the Accused Watches obtains, from the time frequency spectrum, a noise quality index for the segment, the noise quality index being used to determine whether the segment is corrupted by motion and noise artifacts.

344. On information and belief, the algorithm used by the Accused Watches obtains a noise quality index.

345. On information and belief, the algorithm used by the Accused Watches determines a dominant frequency in the time frequency spectrum of the segment.

346. On information and belief, the algorithm used by the Accused Watches normalizes the time frequency spectrum to a total power in a narrow band centered at the dominant frequency.

347. On information and belief, the algorithm used by the Accused Watches determines a first trace of amplitudes in the narrow band spectrum of the time frequency spectrum centered at the dominant frequency.

348. On information and belief, the algorithm used by the Accused Watches determines a second trace of amplitudes in a narrow band spectrum of the time frequency spectrum centered at twice the dominant frequency.

349. On information and belief, the algorithm used by the Accused Watches determines a third trace of amplitudes in a narrow band spectrum of the time frequency spectrum centered at three times the dominant frequency.

350. On information and belief, the algorithm used by the Accused Watches subtracts the first, second and third traces of amplitudes from the time frequency spectrum.

351. On information and belief, the algorithm used by the Accused Watches obtains, after subtracting, a total power remaining in the time frequency spectrum, said total power remaining referred to as a residual noise power.

352. On information and belief, the algorithm used by the Accused Watches determines a difference in frequency between the first trace and the second and third traces, the difference in frequency referred to as a projected difference, the noise quality index being a weighted sum of factors including the residual noise power and the projected difference, weights being selected such that each weighted factor represents less than a predetermined percentage of power in an uncorrupted segment.

353. On information and belief, the algorithm used by the Accused Watches applies a statistical learning method, using the noise quality index, to determine whether the segment is corrupted by motion and noise artifacts or not corrupted by motion and noise artifacts, if motion and noise artifacts are not present, including the segment in determination of a physiological parameter.

354. On information and belief, the Accused Watches utilize Plaintiffs' algorithm and system claims to detect motion and noise artifact and reconstruct algorithms for PPG and equivalent signals. Additionally, the algorithm covers a pulse oximeter embedded with a motion and noise artifact detection algorithm based on extraction of time-varying spectral features that are unique to the clean and corrupted components.

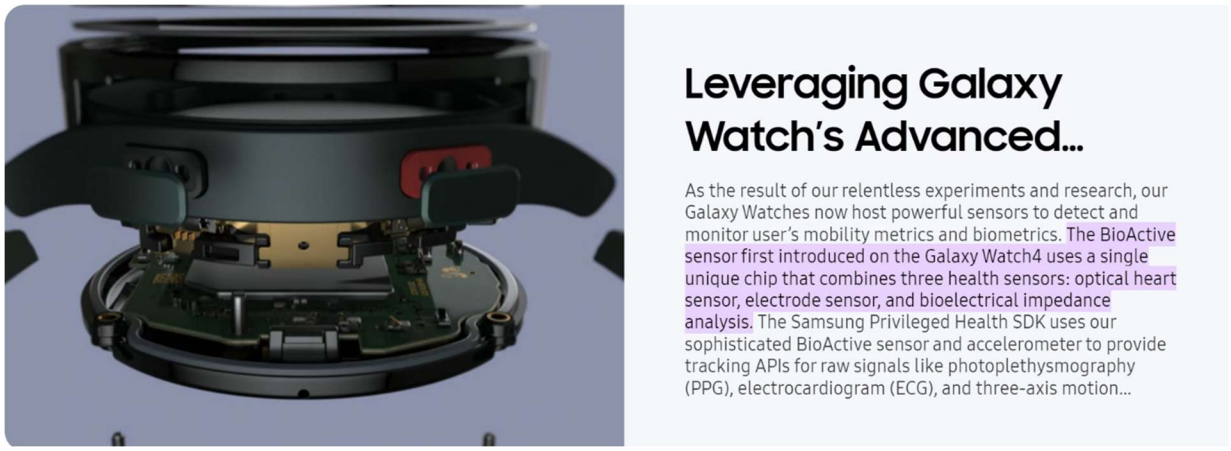
355. On information and belief, the pulse oximeter embedded with a motion and noise artifact detection algorithm using at least one of the sensor described above is shown in the images below found on the Samsung website at:

https://developer.samsung.com/health/privileged ,

https://www.samsung.com/us/watches/galaxy-watch5/#bioactive-sensor ,

https://www.samsung.com/us/support/troubleshooting/TSG01203537/ ,

https://www.samsung.com/au/support/mobile-devices/measure-blood-oxygen-levels/ , https://www.samsung.com/au/watches/galaxy-watch5/buy/



BIOACTIVE SENSOR

Tracking that's state of the heart

BioActive Sensor IC

An improved, **curved sensor design** gets closer to your skin for more accurate heart rate and wellness readings. [2,4]

Optical Heart Rate Sensor

Monitor your heart rate during workouts and as you recover. With heart rate sensors and more, you can optimize your performance to reach new goals. [2]

Samsung smart watch detects unnecessary movements as exercise

When Workout detection is turned on, your Samsung smart watch will automatically detect and record activities you perform like walking, running, and cycling. However, if you're performing other actions or movements, like driving, the watch may think you're performing a workout. You can easily turn off this feature to avoid unnecessary movement being detected as a workout.

Measuring Blood Oxygen Levels on my Galaxy Watch3

Last Update date : Oct 27. 2020

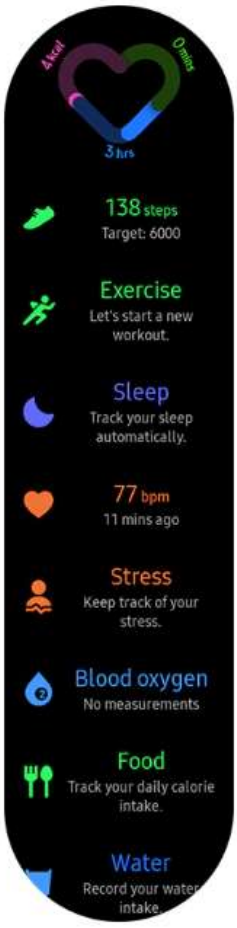
Use your Galaxy Watch3 to measure your Blood Oxygen level. Your blood oxygen level can provide an indication of how effectively your blood is carrying oxygen throughout your body, which in turn can tell you whether you're breathing effectively. Follow the below guide to learn how to setup and measure your Blood Oxygen level on your Galaxy Watch3.

"*Galaxy Watch 3 is not a medical/therapeutic device and is not intended for medical use. It is solely intended for fitness and wellness purposes only and is not intended for use in the diagnosis of disease or other conditions; or in the cure, mitigation, treatment or prevention of disease; or for the prevention or control of pregnancy. Samsung recommends that you consult with your doctor before participating in any exercise program. Using Samsung Health app with Galaxy Watch 3 requires signup and pairing with your compatible smartphone. Fall Detection must be switched on and your Location must be enabled to share with your Emergency contact.

Prior to folloing the below guide ensure that you have updated your Galaxy Watch3 to the most latest software, checkout our guide How to update the software of my Wearable for step-by-step instructions.

1 Head into your Galaxy Watch3 **Apps Tray** and launch **Samsung Health**

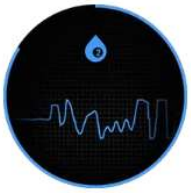
2 Scroll down the list of options and tap on **Blood Oxygen**



3 Select Measure

If you would like to add the Blood Oxygen function as a widget check out our guide Adding a Widget to my Samsung Watch for step-by-step instructions.

4 It is recommended to place your hand on a table and near your heart. Sit still while your watch measures your Blood Oxygen level.



5 Once measured you will be able to view your **Blood Oxygen** level and **Beats per minute (bpm)**

A typically healthy range is 95% to 100%, but factors like exercise, elevation and health conditions can affect your results. For best results, rest at least 5 minutes before measuring, stay still and comfortable during measurement. Individual results may vary.

Snooze to hit your sleep goals

Monitor your sleep with the advanced sleep tracker on the Galaxy Watch5. It is designed to analyse all your different sleep stages while you rest and gives you a sleep score for how well you slept. The Samsung Health App on your Galaxy smartphone lets you see advanced insights such as blood oxygen levels, skin temperature, snoring patterns and even kilojoules burned.*,^,#,**

356. On information and belief, Defendants had knowledge of Plaintiffs' algorithm and apparatus as claimed in Claim 1 through their previous work together, and through Plaintiffs' disclosure through the United States Patent and Trademark Office by obtaining the patent, but in any event at least as of the filing of this lawsuit.

357. Defendants' infringement of the '362 patent is willful, deliberate, and intentional by Defendants. Utilizing their prior knowledge and data of working with Dr. Chon, coupled with public disclosure of Plaintiffs' algorithm and apparatus, Defendants acted willfully, or at a minimum, Defendants took active steps to avoid learning of Plaintiffs' algorithms and patent rights.

358. Defendants were fully aware of Dr. Chon's proprietary and successful results via the data collection and results of various Simband watches, as well as through their communications with him through the years of 2015-2018. Defendants either knew or took active steps to avoid learning of the '362 patent with the specific intent to use or cause others to use the infringing functionality of the Accused Watches.

359. On September 23, 2020, Defendants announced that the Accused Watches were cleared by the FDA to include ECG monitoring via the Samsung Health Monitor app. Defendants stated: "This feature recently received clearance from the U.S. Food and Drug Administration (FDA), and will soon be available through the Samsung Health Monitor app when connected to a compatible Galaxy smartphone. The new ECG Monitor app allows users to monitor their heart rhythm for irregularities, scanning for

signs of Atrial Fibrillation (AFib). To use the ECG Monitor app, simply take a seat, open up the new Samsung Health Monitor app, and ensure your watch is snug to your wrist. Rest your arm on a flat surface, place your fingertip on the top button, and your watch will record an ECG and classify it as either Sinus Rhythm, or AFib……In addition to ECG monitoring, you can also conveniently track oxygen saturation on Galaxy Watch3…..To help improve your sleep so you can recover better, Galaxy Watch3 also comes with advanced sleep tracking features, which measure breathing, vitals, and REM cycles throughout the night, then use an algorithm to score your rest for the evening." The announcement is shown in the image below from Samsung's website at: https://news.samsung.com/us/health-electrocardiogram-monitoring-app-ecg-galaxy-watch3-active2

360. Defendants were made aware of Plaintiffs' intention to file patents, protecting the algorithm and apparatus claims used during their time of work together. However, instead of properly licensing the technology from Plaintiffs, which was

discussed numerous times throughout their working relationship, Defendants chose instead to cease communication and thus, the relationship. Defendants then chose, without any license or permission from Plaintiffs, to utilize and incorporate Plaintiffs' protected intellectual property to create and sell the Accused Watches.

361. The '362 patent solved multiple problems in the prior art and provided specific technical advancements, including as further described below.

362. In addition to the innovations set forth, the '362 patent overcame the limitation of inaccurate detection of heart rates and oxygen saturation values during body movements and instead, a pulse oximeter embedded with a motion and noise artifact detection algorithm is used to extract time-varying spectral features that are unique to the clean and corrupted components for accurate heart rate and oxygen saturation detection.

363. For the reasons set forth, the '362 patent claims are patent eligible because, *inter alia*, they provide specific technological benefits. *See* Exhibit 9.

364. Because of Defendants' infringement of the '362 patent, Plaintiffs have suffered and will continue to suffer irreparable harm and injury, including monetary damages in an amount to be determined at trial.

365. On information and belief, Defendants have acted with full knowledge or at least willful blindness of the '362 patent and without a reasonable basis for believing that they would not be liable for direct infringement of the '362 patent and active inducement of infringement of the '362 patent.

366. Samsung has infringed and continues to infringe the '362 patent by making, using, selling, offering to sell, and/or importing, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '362 patent literally or under the doctrine of equivalents.

367. Samsung has induced infringement and continues to induce infringement of the '362 patent by actively and knowingly inducing others to make, use, sell, offer to sell, and/or import, without license or authority, the Accused Watches as alleged herein, which embody or use the inventions claimed in the '362 patent literally or under the doctrine of equivalents.

368. Samsung markets, advertises, offers for sale, and/or otherwise promotes the Accused Watches and, on information and belief, does so to actively and knowingly induce, encourage, instruct, and aid one or more persons in the United States to make, use, sell, offer to sell and/or import the Accused Watches. For example, Samsung knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Samsung, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Samsung Health Monitor app to monitor physiological parameters. Therein, on information and belief, Samsung describes and touts the use of the subject matter claimed in the '362 patent, as described and alleged herein.

369. Plaintiffs reserve the right to assert additional claims of the '362 patent that Defendants infringe.

370. On information and belief, Samsung has known of the existence of the '362 patent and its applicability to Samsung's Watches, and committed acts of infringement that were willful, demonstrated willful blindness, and disregard for the '362 patent, without any reasonable basis for believing that it had a right to engage in the infringing conduct. Plaintiffs are entitled to increased damages of three times the damages assessed pursuant to 35 U.S.C. § 284, as well as an award of attorney's fees pursuant to 35 U.S.C. § 285.

JURY DEMANDED

Pursuant to Rule 38(b) of the Federal Rules of Civil Procedure, Plaintiffs request a trial by jury on all issues so triable.

PRAYER FOR RELIEF

WHEREFORE, Plaintiffs respectfully request the Court to enter judgment in their favor and against Defendants as follows:

a. finding that Defendants have infringed and are infringing the patents-in-suit;

b. awarding Plaintiffs damages under 35 U.S.C. § 284, or otherwise permitted by law, including treble damages based on Defendants' willful infringement, and damages for any continued post-verdict infringement;

c. awarding Plaintiffs pre-judgment and post-judgment interest on the damages award and costs;

d. declaring this case exceptional pursuant to 35 U.S.C. § 285;

e. awarding costs of this action and attorney fees pursuant to 35 U.S.C. § 285, or as otherwise permitted by law; and

f. awarding such other costs and further relief the Court determines to be just and equitable.

Dated: April 3, 2023

Respectfully submitted,

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