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. HUAWEI DEVICE CO., LTD., Defendant.	Case No. 2:23-cv-553 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 Huawei Device Co., Ltd. ("Defendant" or "Huawei"), for infringement of United States patent nos. 8,417,326 ("the '326 patent"), 9,408,576 ("the '576 patent"), 9,713,428 ("the '428 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. Defendant Huawei Device is a corporation organized and existing under the laws of the People's Republic of China. It has its principal place of business at 8 Shitou Road, North Area, Shenzhen, 518129, People's Republic of China. Huawei Device designs, manufactures, makes, uses, and/or imports watches into the United States. Huawei Device's watches are marketed, used, offered for sale, and/or sold throughout the United States, including within this district.

6. On information and belief, Defendant is 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. These acts of

infringement include inducing and/or contributing to infringement in the U.S. of the patents-in-suits' claims.

JURISDICTION AND VENUE

7. 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.

8. 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.*

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

10. This Court has personal jurisdiction over Defendant at least because, Defendant (i) has purposefully availed themselves of the rights and benefits of the laws of the State of Texas and this Judicial District; (ii) has done and is 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 one or more acts of infringement in the State of Texas and this Judicial District; (iii) maintain continuous and systematic contacts in the State of Texas and this Judicial District; and/or (iv) 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.

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

12. Defendant has 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 Defendant has 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.

13. Specifically, Defendant intends to and does business in Texas, directly or through intermediaries and offers its products or services, including those accused herein of infringement, to customers and potential customers located in Texas, including in the Eastern District of Texas.

14. Defendant currently employs and contracts with individuals who reside and work within the District and commit acts of infringement in the District.

15. Venue is proper in this Court under 28 U.S.C. §§ 1391 and 1400(b) because Defendant is subject to personal jurisdiction in this Judicial District and has committed acts of infringement in this Judicial District. Defendant, 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.

16. Venue is proper as to Defendant because Defendant is a foreign corporation and suits against foreign entities are proper in any judicial district under 28 U.S.C. § 1391(c)(3).

BACKGROUND

The Patents-in-Suit

17. 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]

18. 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]

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

19. To compete in this growing market, companies such as Defendants has worked to ensure that their products offer cutting edge health-related features their consumers desire.

Dr. Chon's Research

20. 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*, algorithms and devices for the detection of physiological functions that do not suffer from the drawbacks of the prior art devices. Pursuant to The State University of New York ("SUNY") patent policy, these patents are owned or co-owned by the Research Foundation.

21. 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 that do not suffer from the drawbacks of the prior art devices. These patents are owned and co-owned by WPI.

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

23. 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.

24. 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.

25. The Universities now commence this patent infringement action on the patents-in-suit to address Defendants 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

26. 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.

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

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

29. 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.

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

31. 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.

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

33. 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.

34. For the reasons set forth above, as well as the '326 being duly issued by the United States Patent Office, the ’326 patent is presumed valid, rights have been conferred upon Plaintiffs to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States. *See* Exhibit 1.

35. 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. 9,408,576

36. U.S. Patent No. 9,408,576, entitled “Detection and Monitoring of Atrial Fibrillation,” (attached as Exhibit 2), was duly and legally issued on August 9, 2016.

37. The ’576 patent will expire on May 12, 2034.

38. The inventors named on the ’576 patent are Ki. H. Chon and Jowoon Chong.

39. 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.

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

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

42. 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.

43. For the reasons set forth above, as well as the '576 being duly issued by the United States Patent Office, the ’576 patent is presumed valid, rights have been conferred upon Plaintiffs to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States. *See* Exhibit 2.

44. 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

45. U.S. Patent No. 9,713,428, entitled "Physiological Parameter Monitoring with a Mobile Communication Device," (attached as Exhibit 3), was duly and legally issued on July 25, 2017.

46. The '428 patent will expire on April 23, 2032.

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

48. 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.

49. 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.

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

51. 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.

52. For the reasons set forth above, as well as the '428 being duly issued by the United States Patent Office, the ’428 patent is presumed valid, rights have been conferred upon Plaintiffs to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States. *See* Exhibit 3.

53. 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. 9,986,921

54. U.S. Patent No. 9,986,921, entitled “Detection and Monitoring of Atrial Fibrillation,” (attached as Exhibit 4), was duly and legally issued on June 5, 2018.

55. The ’921 patent will expire on May 1, 2035.

56. The inventors named on the ’921 patent are Ki. H. Chon and Jowoon Chong.

57. 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.

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

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

60. 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.

61. For the reasons set forth above, as well as the '921 being duly issued by the United States Patent Office, the ’921 patent is presumed valid, rights have been conferred upon Plaintiffs to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States. . *See* Exhibit 4.

62. 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

63. U.S. Patent No. 10,278,647, entitled "Method and Apparatus for Removing Motion Artifacts from Biomedical Signals," (attached as Exhibit 5), was duly and legally issued on May 7, 2019.

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

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

66. 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.

67. 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.

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

69. 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.

70. For the reasons set forth above, as well as the '647 being duly issued by the United States Patent Office, the ‘647 patent is presumed valid, rights have been conferred upon Plaintiffs to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States. *See* Exhibit 5.

71. 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

72. U.S. Patent No. 10,285,601, entitled “Detection and Monitoring of Atrial Fibrillation,” (attached as Exhibit 6), was duly and legally issued on May 14, 2019.

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

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

75. 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.

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

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

78. 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.

79. For the reasons set forth above, as well as the '601 being duly issued by the United States Patent Office, the ‘601 patent is presumed valid, rights have been conferred upon Plaintiffs to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States. *See* Exhibit 6.

80. 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

81. U.S. Patent No. 10,653,362, entitled “Motion and Noise Artifact Detection and Reconstruction Algorithms for Photoplethysmogram and Equivalent Signals,” (attached as Exhibit 7), was duly and legally issued on May 19, 2020.

82. The ’362 patent will expire on November 28, 2037.

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

84. 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.

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

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

87. 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.

88. For the reasons set forth above, as well as the '362 being duly issued by the United States Patent Office, the ’362 patent is presumed valid, rights have been conferred upon Plaintiffs to exclude others from making, using, offering for sale, or selling the invention throughout the United States or importing the invention into the United States. *See* Exhibit 7.

89. 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.

Huawei Watches

90. On information and belief, Huawei manufactures and sells multiple models and/or versions of the Huawei Smartwatches. *See* https://consumer.huawei.com/en/wearables/ attached as Exhibit 8.

91. As stated on Huawei's website, the Huawei Smartwatches tracks "seven key indicators all at one time, including the heart rate, SpO2 level, respiratory overview, and cardiovascular health." *See* https://consumer.huawei.com/en/wearables/watch-4-series/

92. Huawei's website also lists, generally, the Huawei watches' main features, noting their ability to "stay informed of abnormal heart rate, and SpO_2 readings as soon as they occur, and view graphs of long-term health trends in the ever-handy Huawei Health app." *Id.*

93. The Huawei Watch Ultimate model is shown in the image below. The watch is featured in the Huawei Watch Ultimate User Guide as an example of the various models and/or versions of the Huawei Smartwatches that Huawei manufactures, uses, sells, offers to sell, and/or imports into the United States. *See* file:///C:/Users/cmcarni/Downloads/HUAWEI%20WATCH%20Ultimate%20User%20Guide-(CLB-B19,02,en-us).pdf

PATENT INFRINGEMENT

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

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

95. On information and belief, Huawei's products, including at least the, Huawei Watch 4 Series, Huawei Watch Ultimate, Huawei Watch GT Cyber, Huawei Watch GT 3 Pro Titanium, Huawei Watch GT 3 Pro Ceramic, Huawei Watch GT3, Huawei Watch GT Runner, Huawei Watch FIT Special Edition, Huawei Watch D, Huawei Watch GT 3 SE, Huawei Watch Fit 2, Huawei Watch 3, Huawei Watch 3 Pro, Huawei Watch GT 2 Pro, Huawei Watch GT 2, Huawei Watch GT 2e, Huawei Watch FIT Mini, Huawei Watch FIT new, Huawei Band 8, and the Huawei Band 7 ("the Accused Watches"), infringe at least Claim 1 of the '326 patent under 35 U.S.C. §271.

96. On information and belief, Huawei has 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, Huawei Watch 4 Series, Huawei Watch Ultimate, Huawei Watch GT Cyber, Huawei Watch GT 3 Pro Titanium, Huawei Watch GT 3 Pro Ceramic, Huawei Watch GT3, Huawei Watch GT Runner, Huawei Watch FIT Special Edition, Huawei Watch D, Huawei Watch GT 3 SE, Huawei Watch Fit 2, Huawei Watch 3, Huawei Watch 3 Pro, Huawei Watch GT 2 Pro, Huawei Watch GT 2, Huawei Watch GT 2e, Huawei Watch FIT Mini, Huawei Watch FIT new, Huawei Band 8, and the Huawei Band 7.

97. The above-listed watches are non-limiting. Additional products of Huawei may infringe the '326 patent, and the above-listed watches may infringe additional patents.

98. On information and belief, at least the Accused Watches listed above are sold with the Huawei Health app infringing technology/algorithms. Each patent listed in this Complaint includes at least method claims, system claims and/or apparatus claims.

99. 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;

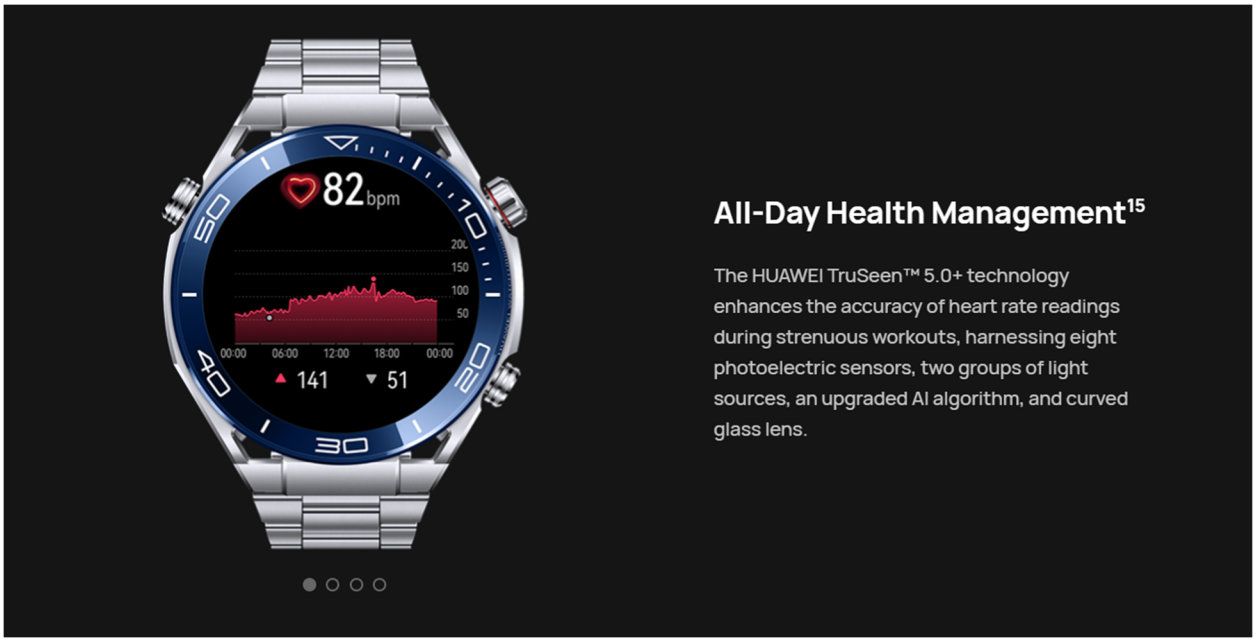
and calculating Shannon Entropy (SE) of the N heart beat intervals.

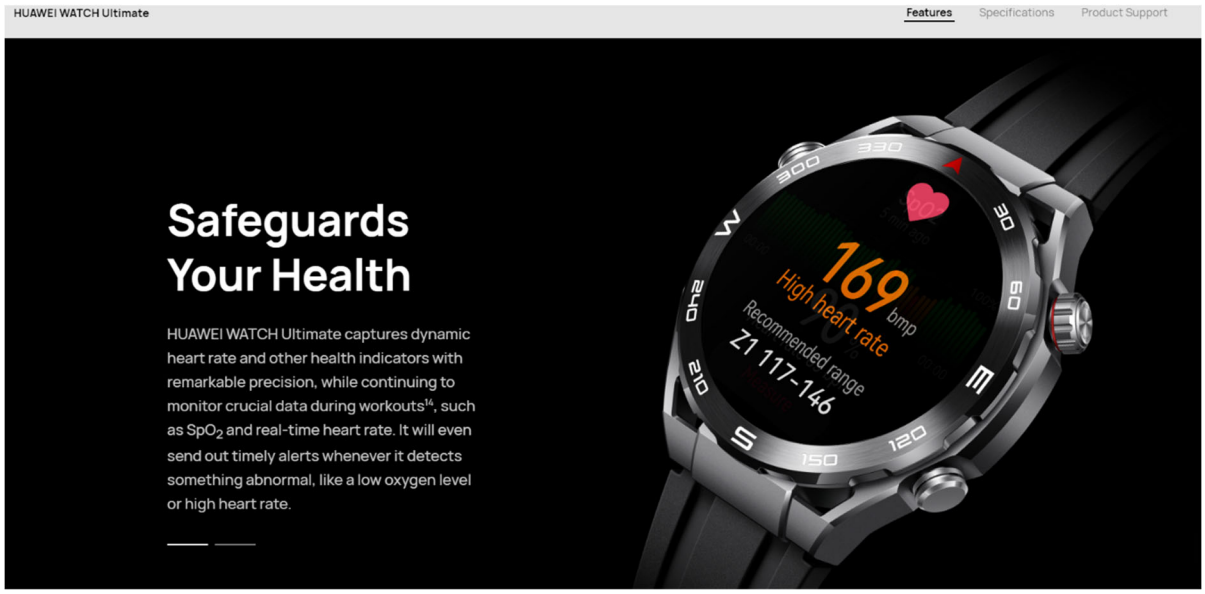
100. On information and belief, the algorithm used by the Accused Watches does AF analysis, including as shown below.

https://consumer.huawei.com/en/wearables/watch-d/https://consumer.huawei.com/en/wearables/watch-ultimate/https://consumer.huawei.com/en/wearables/band8/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

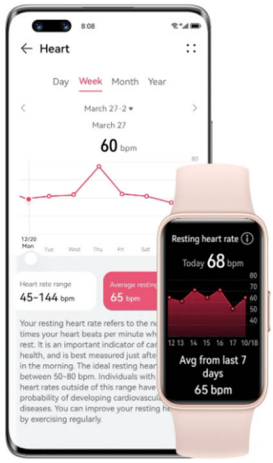
HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.


82 bpm
141
51
All-Day Health Management[15]
The HUAWEI TruSeen™ 5.0+ technology enhances the accuracy of heart rate readings during strenuous workouts, harnessing eight photoelectric sensors, two groups of light sources, an upgraded AI algorithm, and curved glass lens.


HUAWEI WATCH Ultimate
Features
Specifications
Product Support
Safeguards Your Health
HUAWEI WATCH Ultimate captures dynamic heart rate and other health indicators with remarkable precision, while continuing to monitor crucial data during workouts[14], such as SpO_2 and real-time heart rate. It will even send out timely alerts whenever it detects something abnormal, like a low oxygen level or high heart rate.
169 bmp
High heart rate
Recommended range
Z1 117-146

HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



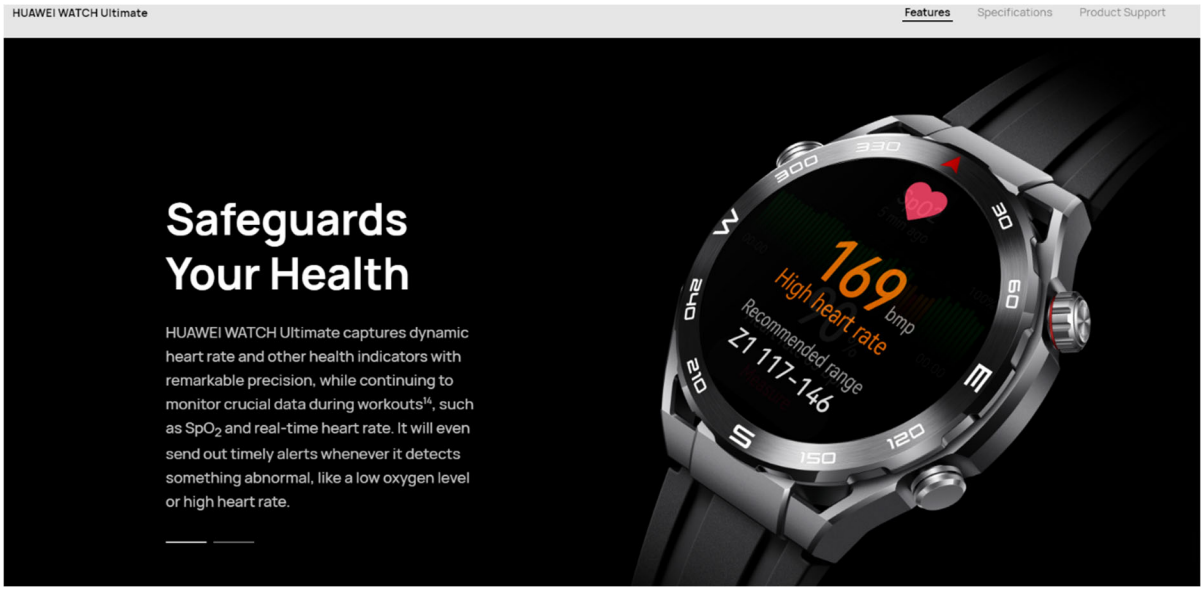
HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.

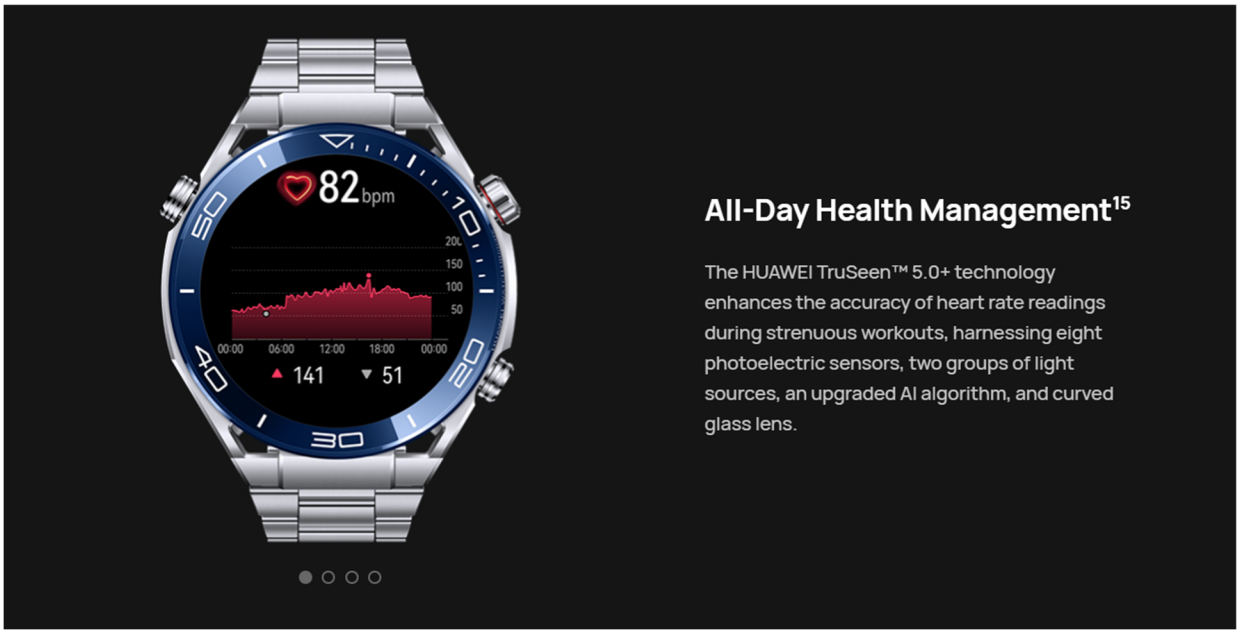
101. The algorithm used by the Accused Watches obtains an output that includes a heart beat, including as shown below.

https://consumer.huawei.com/en/wearables/watch-d/https://consumer.huawei.com/en/wearables/watch-ultimate/https://consumer.huawei.com/en/wearables/band8/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

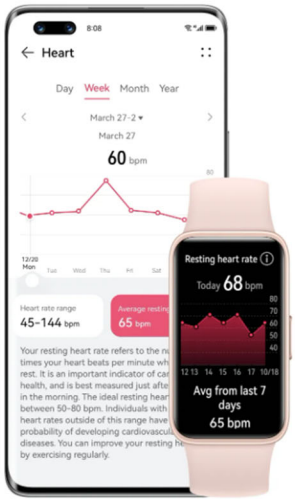
HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.


HUAWEI WATCH Ultimate
Features
Specifications
Product Support
Safeguards Your Health
HUAWEI WATCH Ultimate captures dynamic heart rate and other health indicators with remarkable precision, while continuing to monitor crucial data during workouts[14], such as SpO_2 and real-time heart rate. It will even send out timely alerts whenever it detects something abnormal, like a low oxygen level or high heart rate.
169 bmp
High heart rate
Recommended range
117-146


82 bpm
141
51
All-Day Health Management[15]
The HUAWEI TruSeen™ 5.0+ technology enhances the accuracy of heart rate readings during strenuous workouts, harnessing eight photoelectric sensors, two groups of light sources, an upgraded AI algorithm, and curved glass lens.

HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



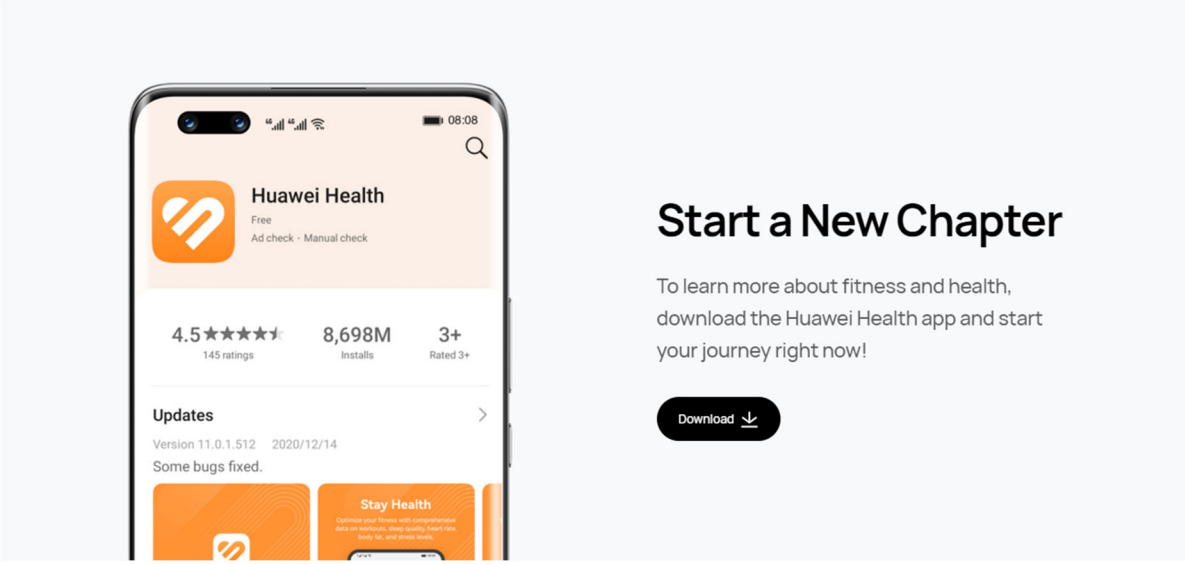
HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.

HUAWEI TruSport™

Enhances Your Fitness

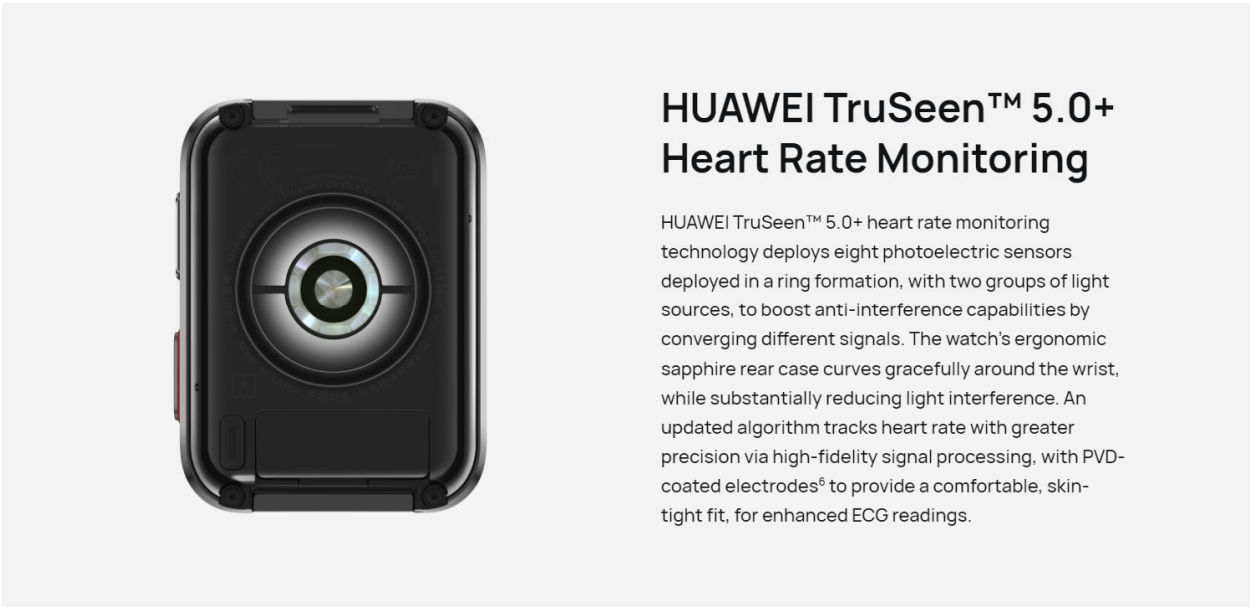
100 band-tastic workout* modes[9] are here for you to choose from. The band will even recognise when you're running and walking, and automatically detect any of the four major swimming strokes, as well as provide real-time heart rate monitoring during swimming. You can even get rewarded with a wealth of wondrous data, including running ability index (RAI), weekly training load, recovery, and VO_2Max[10] with TruSport™ system support. AI running plan in HUAWEI Health app helps you get the most out of every step or stride.

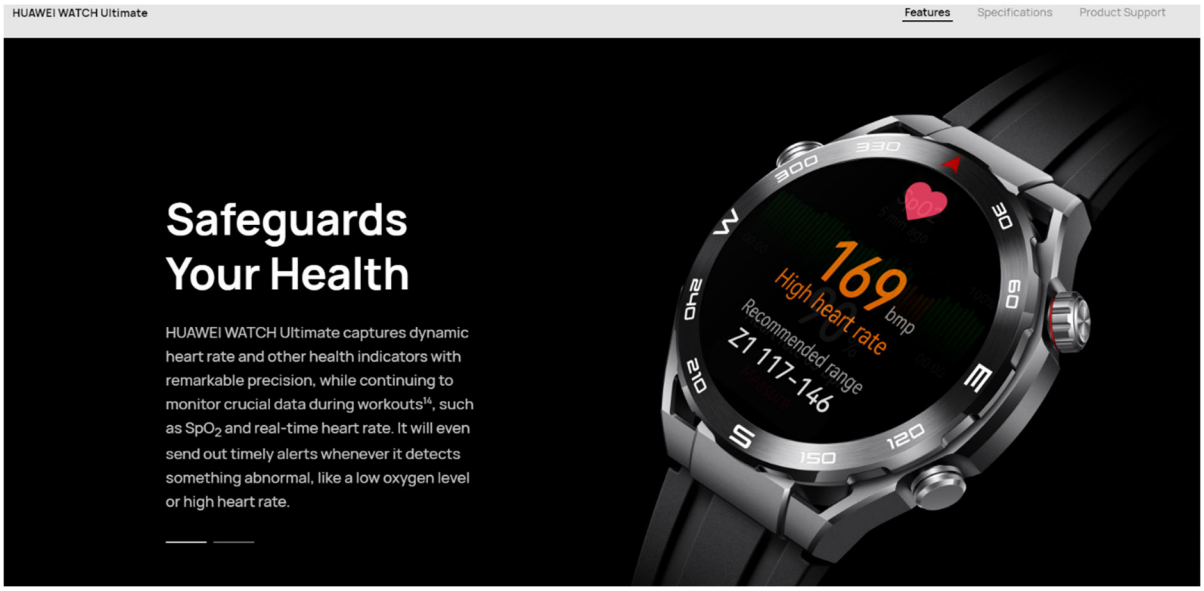
Enrich your training with a pro-level evaluation ›

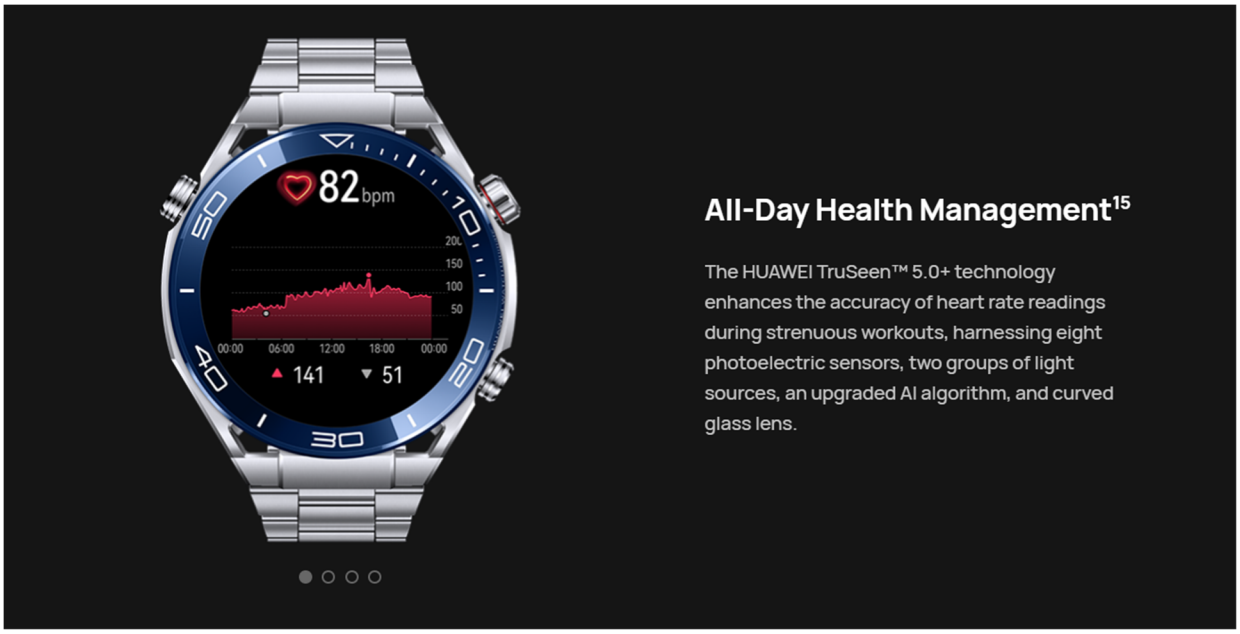


102. The algorithm used by the Accused Watches derives a heart beat interval, including as shown below.

https://consumer.huawei.com/en/wearables/watch-d/https://consumer.huawei.com/en/wearables/watch-ultimate/https://consumer.huawei.com/en/wearables/band8/

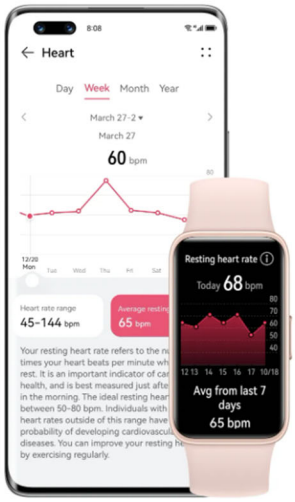



HUAWEI WATCH Ultimate
Features
Specifications
Product Support
Safeguards Your Health
HUAWEI WATCH Ultimate captures dynamic heart rate and other health indicators with remarkable precision, while continuing to monitor crucial data during workouts[14], such as SpO_2 and real-time heart rate. It will even send out timely alerts whenever it detects something abnormal, like a low oxygen level or high heart rate.
169 bmp
High heart rate
Recommended range
Z1 117-146


82 bpm
141
51
All-Day Health Management[15]
The HUAWEI TruSeen™ 5.0+ technology enhances the accuracy of heart rate readings during strenuous workouts, harnessing eight photoelectric sensors, two groups of light sources, an upgraded AI algorithm, and curved glass lens.

HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.

HUAWEI TruSport™

Enhances Your Fitness

100 band-tastic workout* modes[9] are here for you to choose from. The band will even recognise when you're running and walking, and automatically detect any of the four major swimming strokes, as well as provide real-time heart rate monitoring during swimming. You can even get rewarded with a wealth of wondrous data, including running ability index (RAI), weekly training load, recovery, and VO_2Max[10] with TruSport™ system support. AI running plan in HUAWEI Health app helps you get the most out of every step or stride.

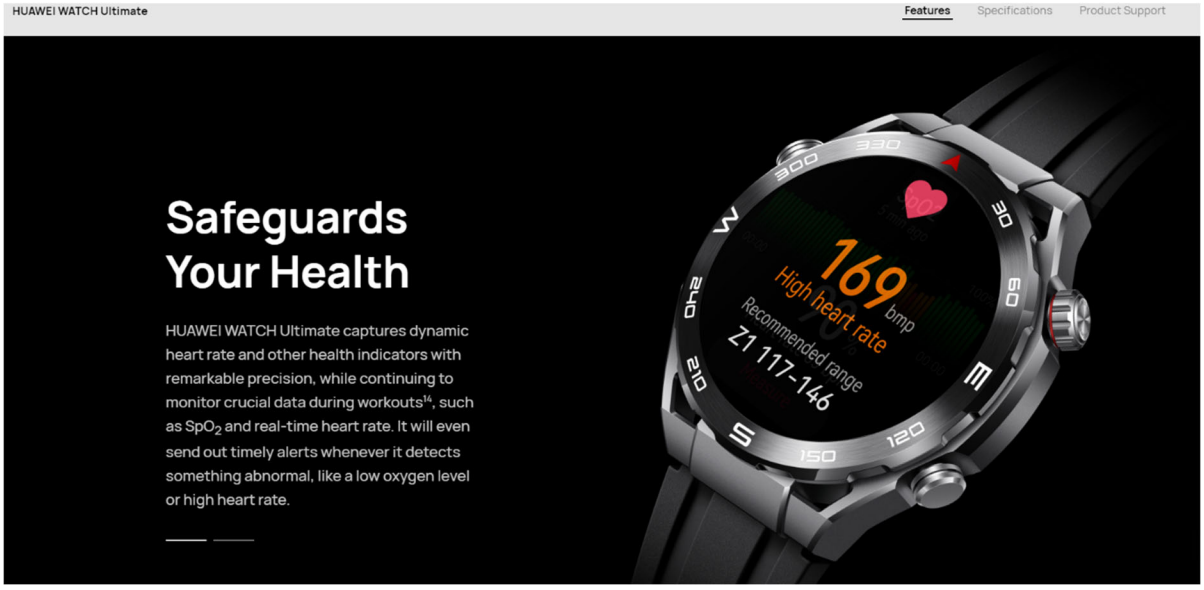
Enrich your training with a pro-level evaluation >

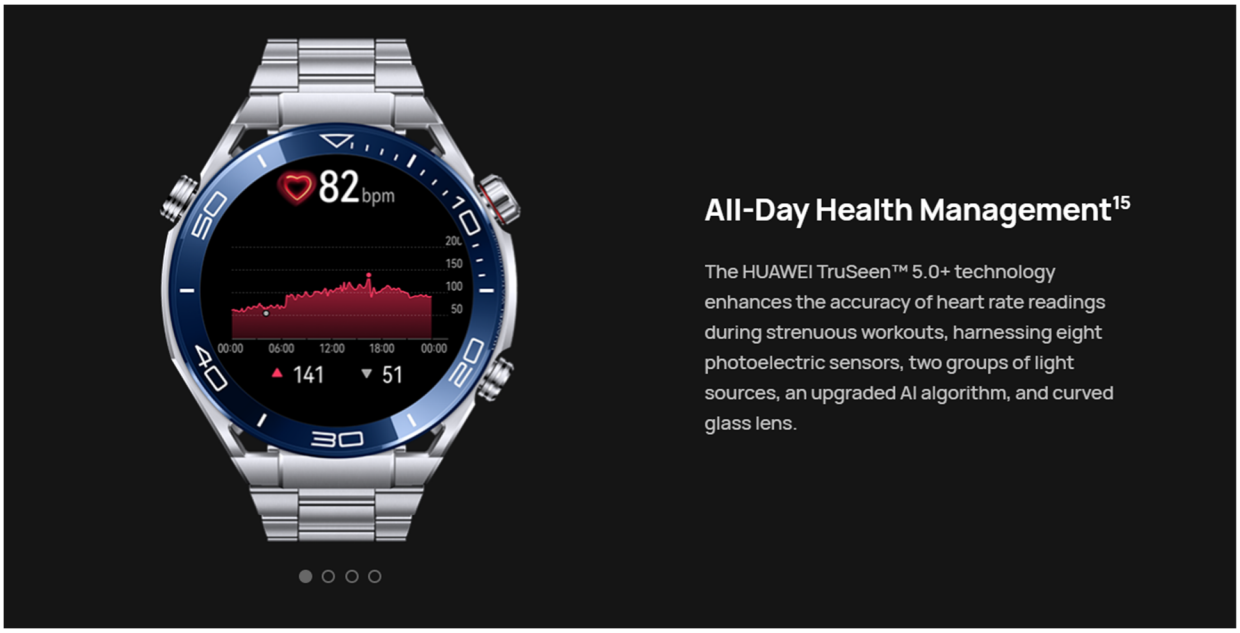
103. The algorithm used by the Accused Watches analyzes a number (N) of heart beat intervals from the output, including as shown below.

https://consumer.huawei.com/en/wearables/watch-d/https://consumer.huawei.com/en/wearables/watch-ultimate/https://consumer.huawei.com/en/wearables/band8/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

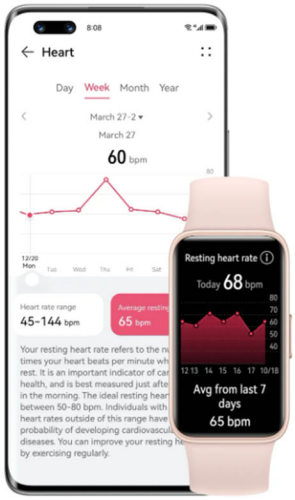
HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.



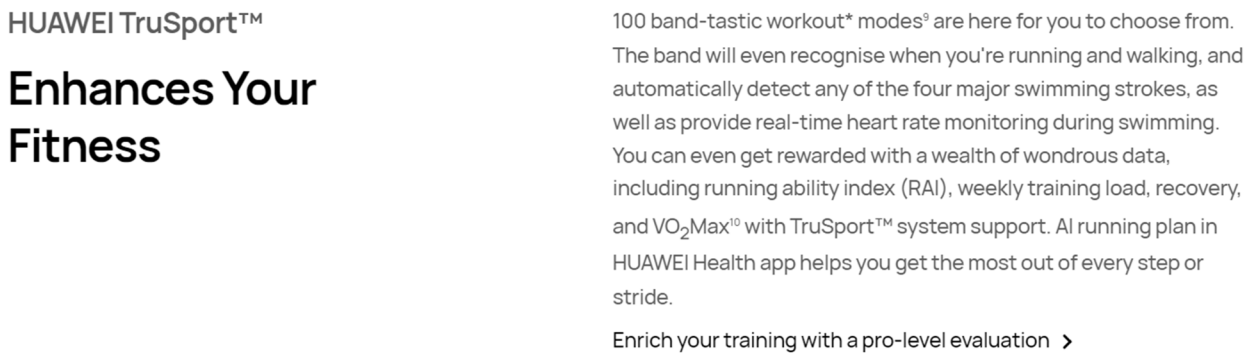


HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.



104. On information and belief, the algorithm used by the Accused Watches detects 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.

105. On information and belief, Huawei had knowledge of Plaintiffs' algorithm and systems as claimed in Claim 1, including from the publication of the '326 patent claims by the United States Patent and Trademark Office, but in any event at least as of the filing of this lawsuit.

106. Huawei's infringement of the '326 patent is willful, deliberate, and intentional. On information and belief, Huawei has known of the '326 patent and its infringement of that patent since at least the filing of this Complaint.

107. Because of Huawei's 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.

108. On information and belief, Huawei has 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.

109. Huawei 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.

110. Huawei 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.

111. Huawei 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, Huawei knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Huawei, or one or more related entities, induces end users by, for example, instructing users of the Accused Watches in its manual to use its Huawei Health app to monitor physiological parameters. Therein, on information and belief, Huawei describes and

touts the use of the subject matter claimed in the '326 patent, as described and alleged herein.

112. Plaintiffs reserve the right to assert additional claims of the '326 patent that Huawei infringes.

113. On information and belief, Huawei has known of the existence of the '326 patent and its applicability to the Accused Watches since at least the filing of this Complaint, 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. 9,408,576 by Huawei

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

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

116. On information and belief, Huawei has 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.

117. The above-listed watches are non-limiting. Additional products of Huawei may infringe the '576 patent, and the above-listed watches may infringe additional patents.

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

119. 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.

120. On information and belief, 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.

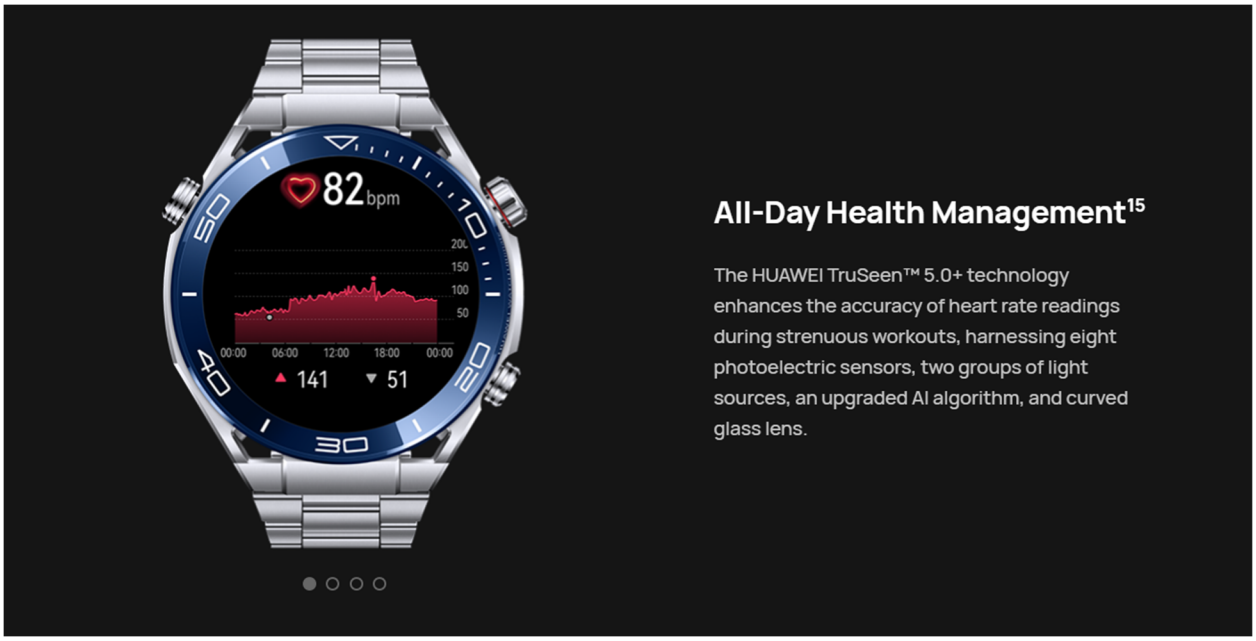
https://consumer.huawei.com/en/wearables/watch-d/

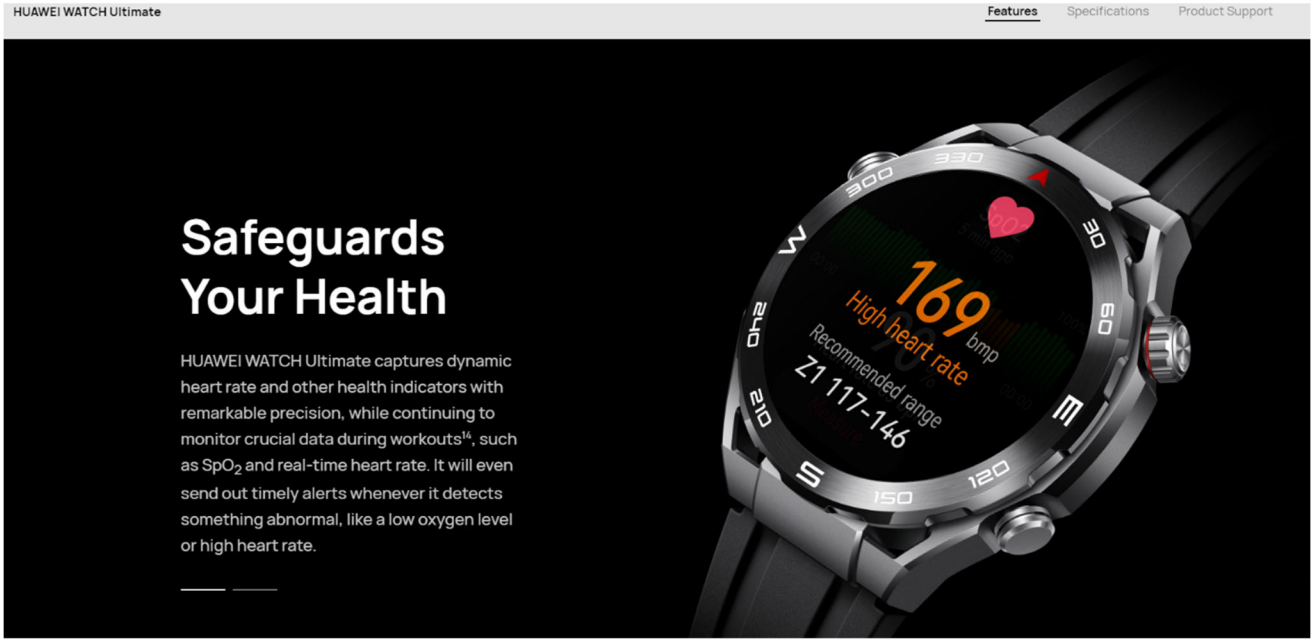
https://consumer.huawei.com/en/wearables/watch-ultimate/

https://consumer.huawei.com/en/wearables/band8/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.


82 bpm
141
51
All-Day Health Management[15]
The HUAWEI TruSeen™ 5.0+ technology enhances the accuracy of heart rate readings during strenuous workouts, harnessing eight photoelectric sensors, two groups of light sources, an upgraded AI algorithm, and curved glass lens.


HUAWEI WATCH Ultimate
Features
Specifications
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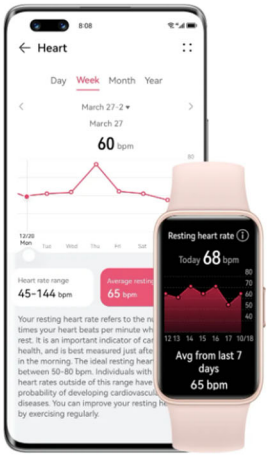
Safeguards Your Health
HUAWEI WATCH Ultimate captures dynamic heart rate and other health indicators with remarkable precision, while continuing to monitor crucial data during workouts[14], such as SpO2 and real-time heart rate. It will even send out timely alerts whenever it detects something abnormal, like a low oxygen level or high heart rate.
169 bmp
High heart rate
Recommended range
117-146

HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.

121. 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.

122. 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.

123. 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.

124. 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.

125. 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.

126. 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.

127. 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.

128. 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.

129. 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.

130. 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.

131. 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.

132. On information and belief, Huawei had knowledge of Plaintiffs' algorithm as claimed in Claim 1 including from the publication of the '576 patent claims the United States Patent and Trademark Office, but in any event at least as of the filing of this lawsuit.

133. Huawei's infringement of the '576 patent is willful, deliberate, and intentional. On information and belief, Huawei has known of the '576 patent and its infringement of that patent since at least the filing of this Complaint.

134. Because of Huawei's 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.

135. On information and belief, Huawei has 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.

136. Huawei 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.

137. Huawei 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.

138. Huawei 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, Huawei knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Huawei, or one or more related entities, induces end users by, for example, instructing users of the Accused Watches in its manual to use its Huawei Health app to monitor physiological parameters. Therein, on information and belief, Huawei describes and

touts the use of the subject matter claimed in the '576 patent, as described and alleged herein.

139. Plaintiffs reserve the right to assert additional claims of the '576 patent that Huawei infringes.

140. On information and belief, Huawei has known of the existence of the '576 patent and its applicability to the Accused Watches since at least the filing of this lawsuit, 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 III: Infringement of United States Patent No. 9,713,428 by Huawei

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

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

143. On information and belief, Huawei has 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.

144. The above-listed watches are non-limiting. Additional products of Huawei may infringe the '428 patent, and the above-listed watches may infringe additional patents.

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

146. 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.

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

https://consumer.huawei.com/en/wearables/watch-d/

https://consumer.huawei.com/en/wearables/band8/

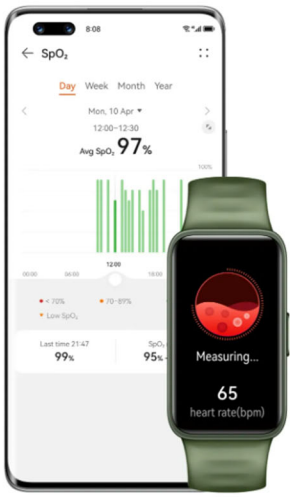
https://consumer.huawei.com/en/wearables/watch-ultimate/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.

HUAWEI TruSeen™ 5.0

SpO_2 Tracking



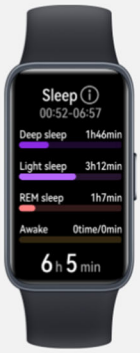
Smart TruSeen™ 5.0 capabilities allow the band to automatically track your SpO_2 level[7], and notify you immediately if it ever drops below the ideal range, so that you can get back to feel good in no time.

All-Day Health Management[15]

With SpO_2 measurements, made possible by HUAWEI TruSeen™ 5.0+ heart rate monitoring technology[14], you can rest assured knowing that when it comes to HUAWEI WATCH Ultimate, caring runs in the blood!

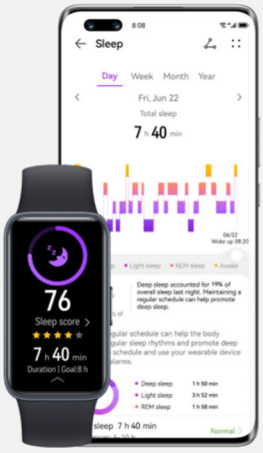
During sleep

Offers multi-dimensional sleep metric tracking.



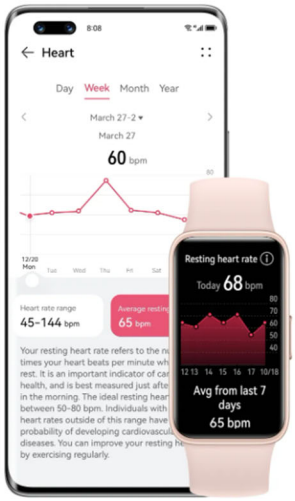
After wakeup

Just raise your wrist after you wake to get last night's sleep report, or open the Huawei Health app to get the detailed data.



HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



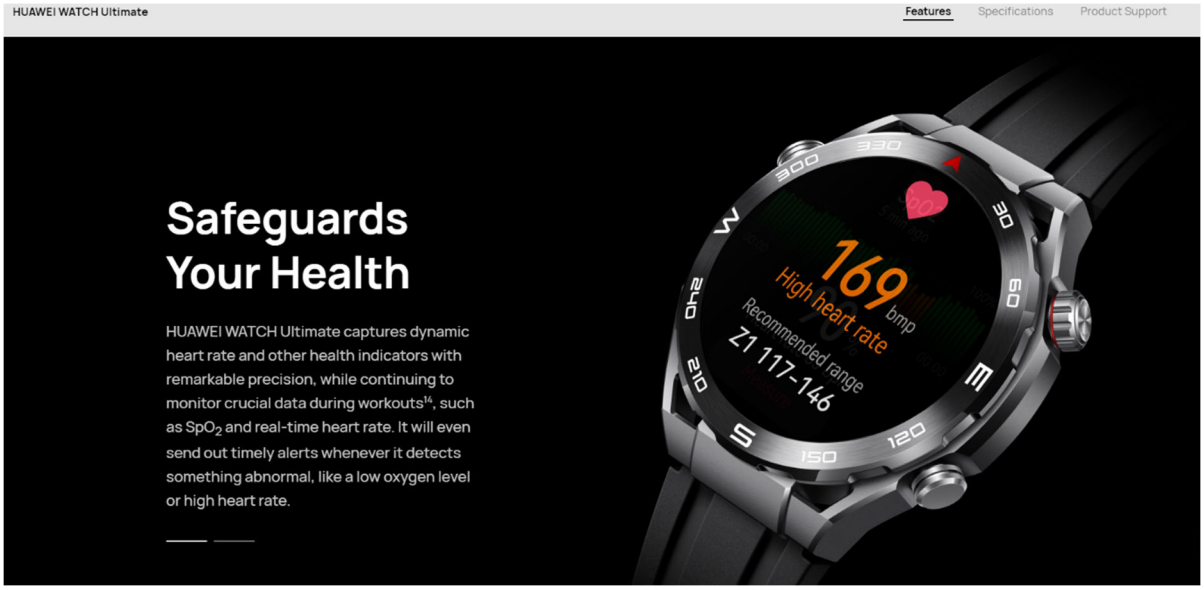
HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.

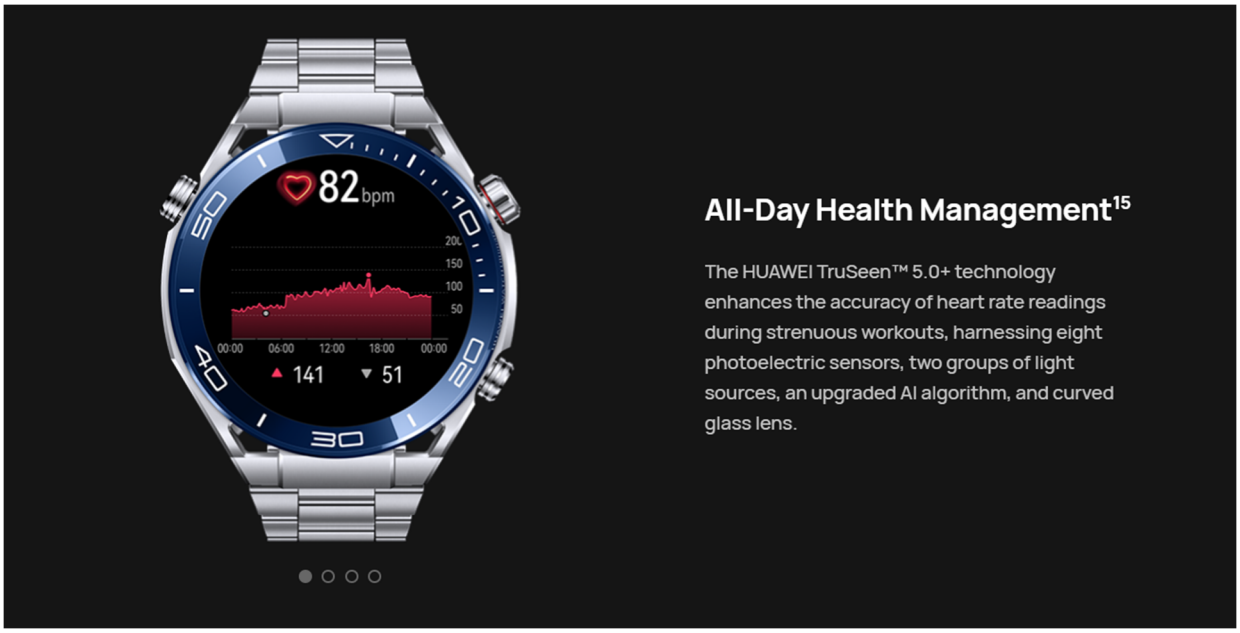
HUAWEI TruSport™

Enhances Your Fitness

100 band-tastic workout* modes[9] are here for you to choose from. The band will even recognise when you're running and walking, and automatically detect any of the four major swimming strokes, as well as provide real-time heart rate monitoring during swimming. You can even get rewarded with a wealth of wondrous data, including running ability index (RAI), weekly training load, recovery, and VO_2Max[10] with TruSport™ system support. AI running plan in HUAWEI Health app helps you get the most out of every step or stride.

Enrich your training with a pro-level evaluation >





148. 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://consumer.huawei.com/en/wearables/watch-d/

https://consumer.huawei.com/en/wearables/band8/

https://consumer.huawei.com/en/wearables/watch-ultimate/

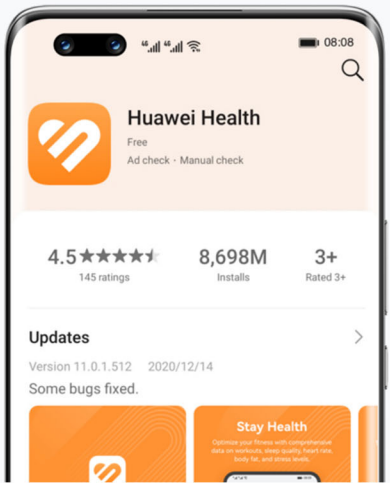
https://consumer.huawei.com/en/support/content/en-us00733859/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.

Compatible with More Devices

HUAWEI Band 8 works seamlessly with both iOS and Android smartphones[3].



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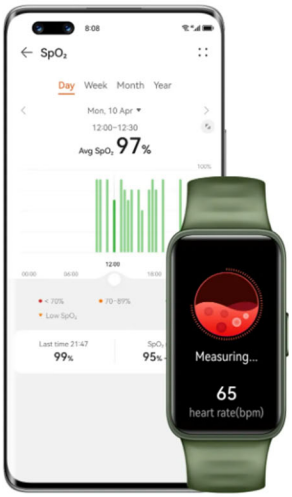
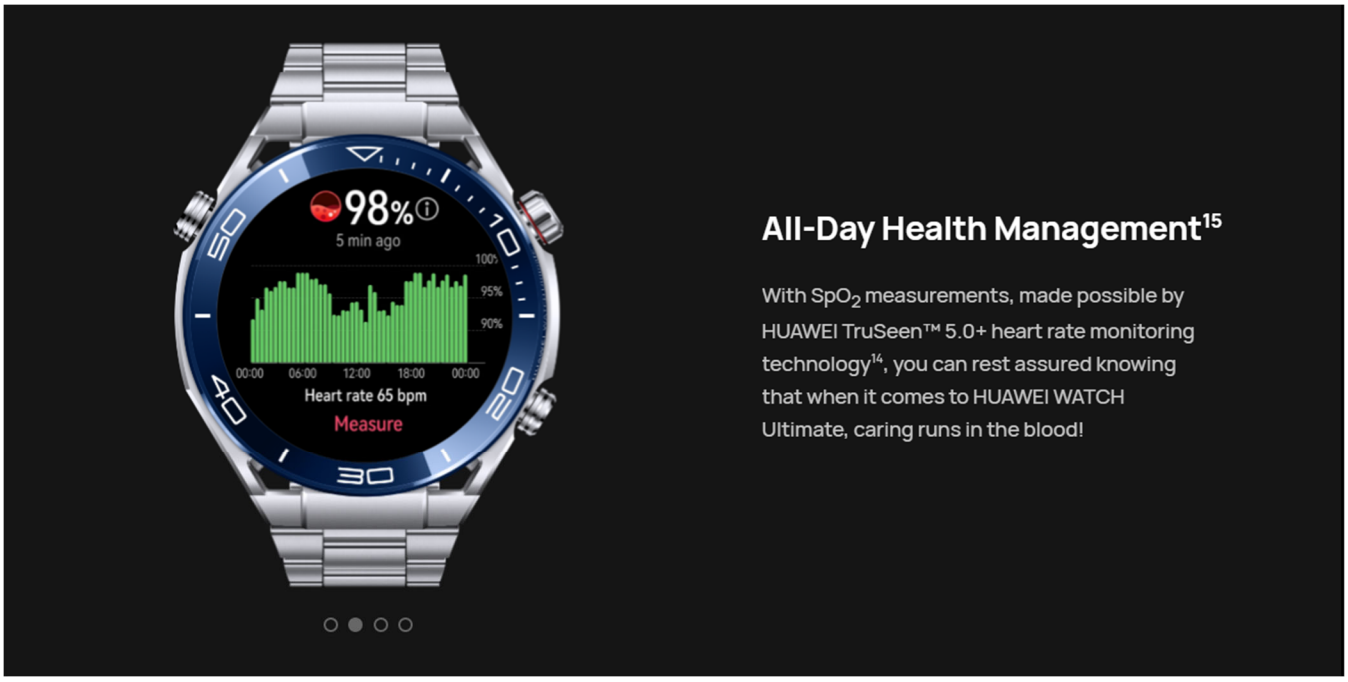
HUAWEI TruSeen™ 5.0

SpO_2 Tracking

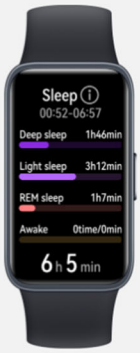


Smart TruSeen™ 5.0 capabilities allow the band to automatically track your SpO_2 level[7], and notify you immediately if it ever drops below the ideal range, so that you can get back to feel good in no time.



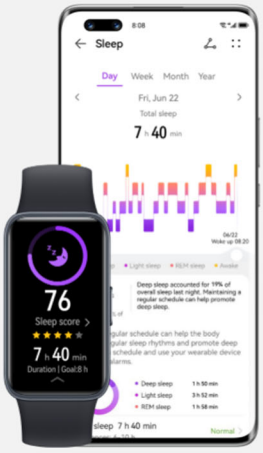
During sleep

Offers multi-dimensional sleep metric tracking.



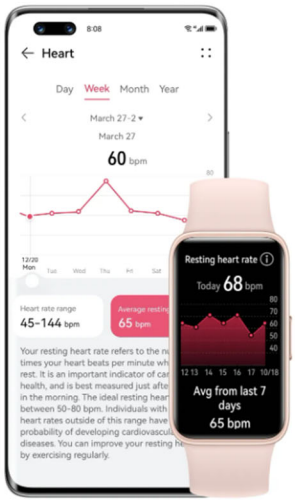
After wakeup

Just raise your wrist after you wake to get last night's sleep report, or open the Huawei Health app to get the detailed data.



HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



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HUAWEI TruSport™

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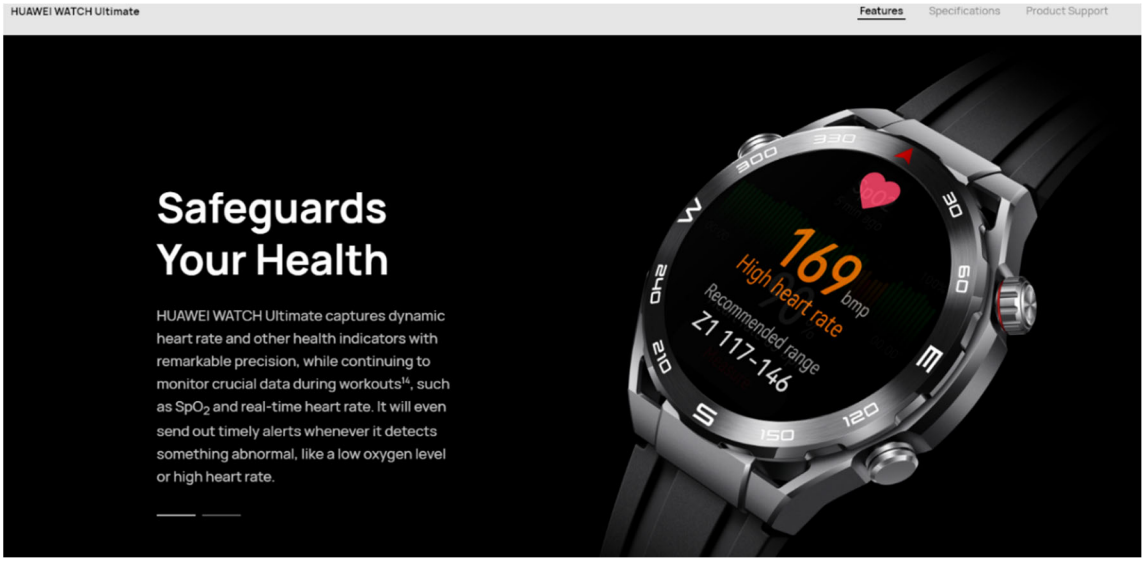
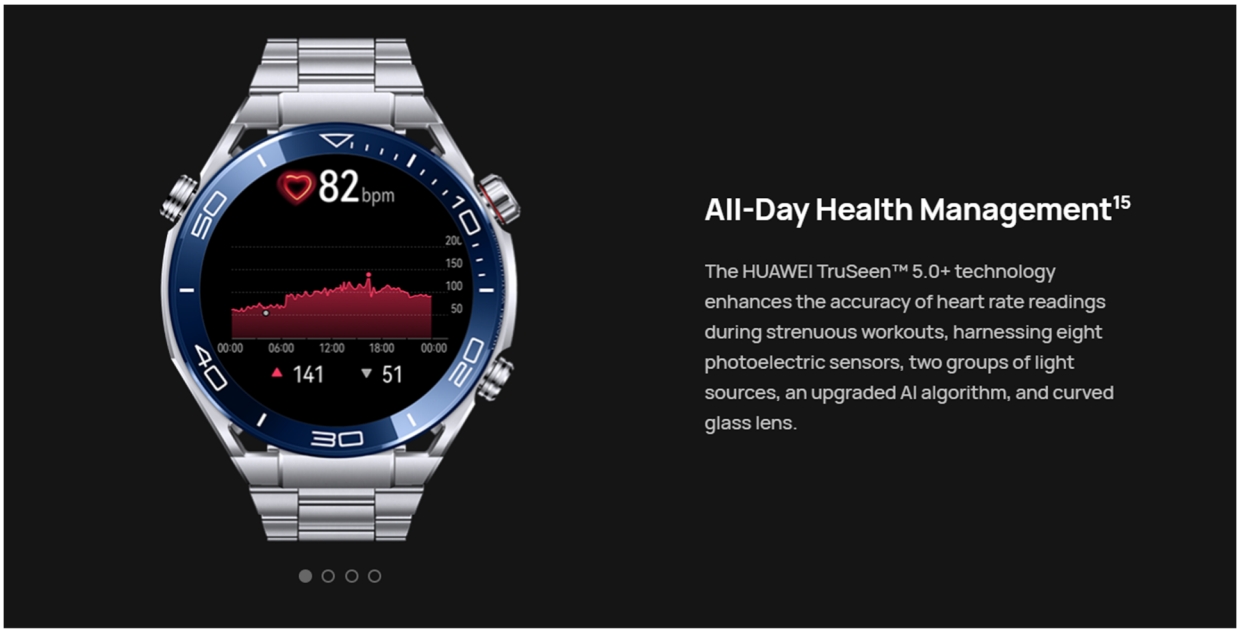
Enrich your training with a pro-level evaluation >





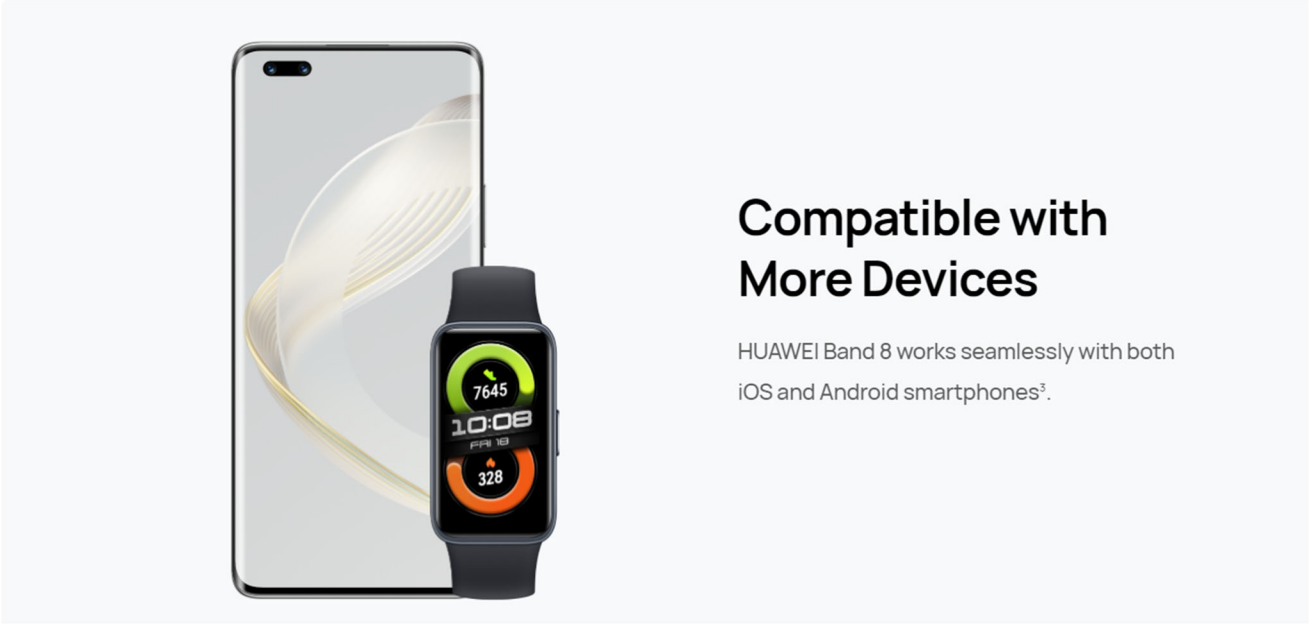
How does the wearable device measure your heart rate

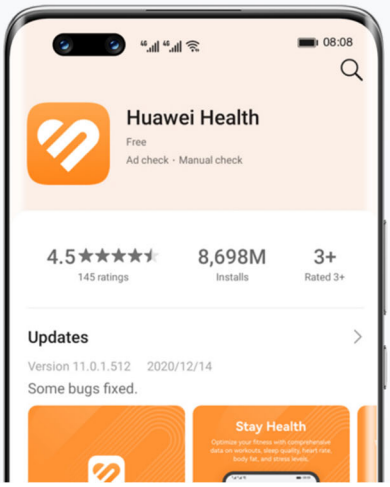
Your heart rate is measured with the optical heart rate sensor on the back of your wearable device, which measures the blood flow changes in your wrist by emitting light into your skin, and detecting how much the light is reflected back.

149. 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://consumer.huawei.com/en/wearables/band8/

https://consumer.huawei.com/en/wearables/watch-ultimate/





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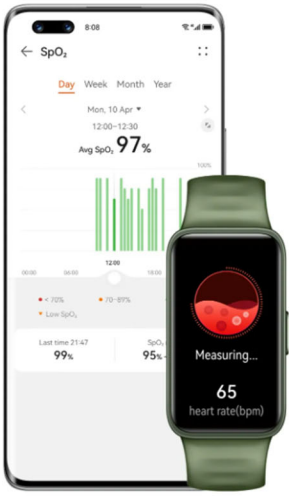
HUAWEI TruSeen™ 5.0

SpO_2 Tracking



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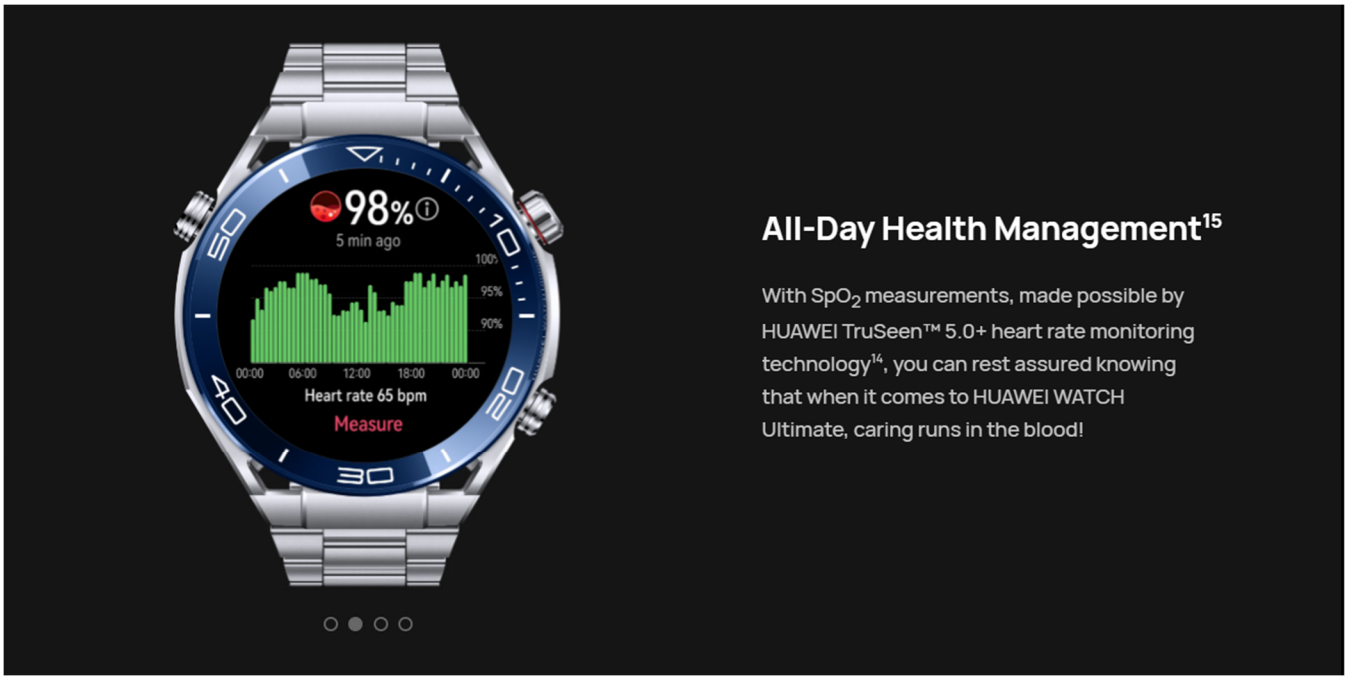

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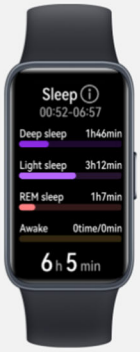

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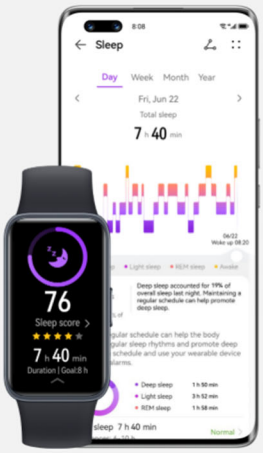
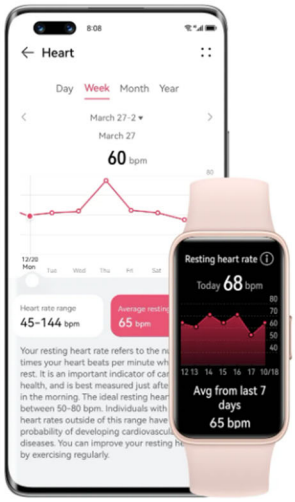


HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



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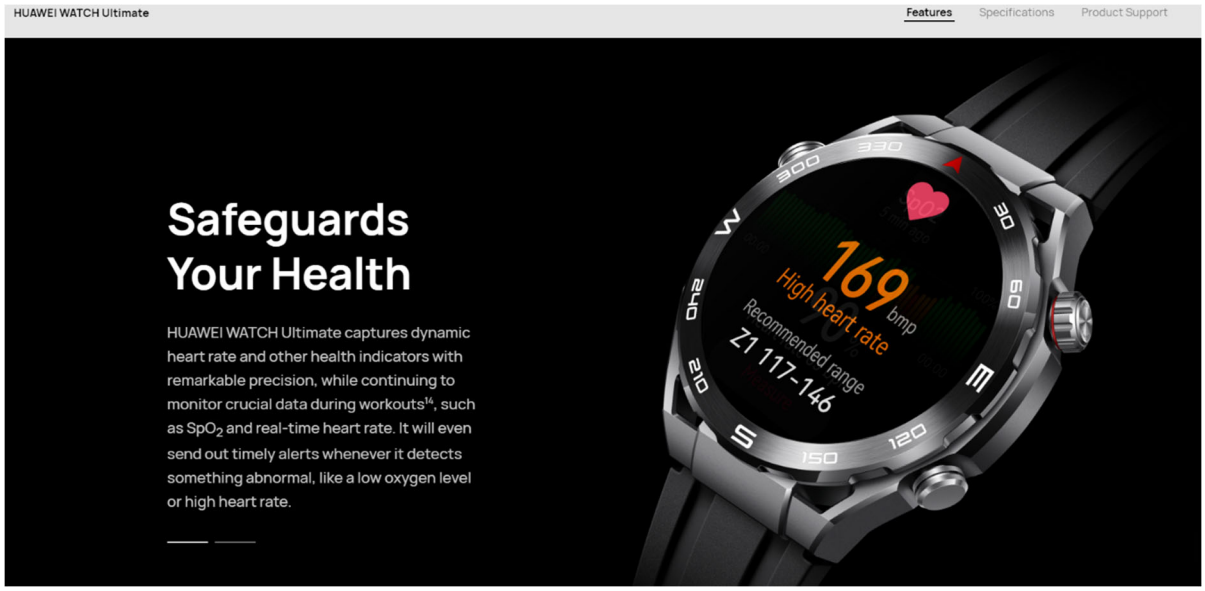
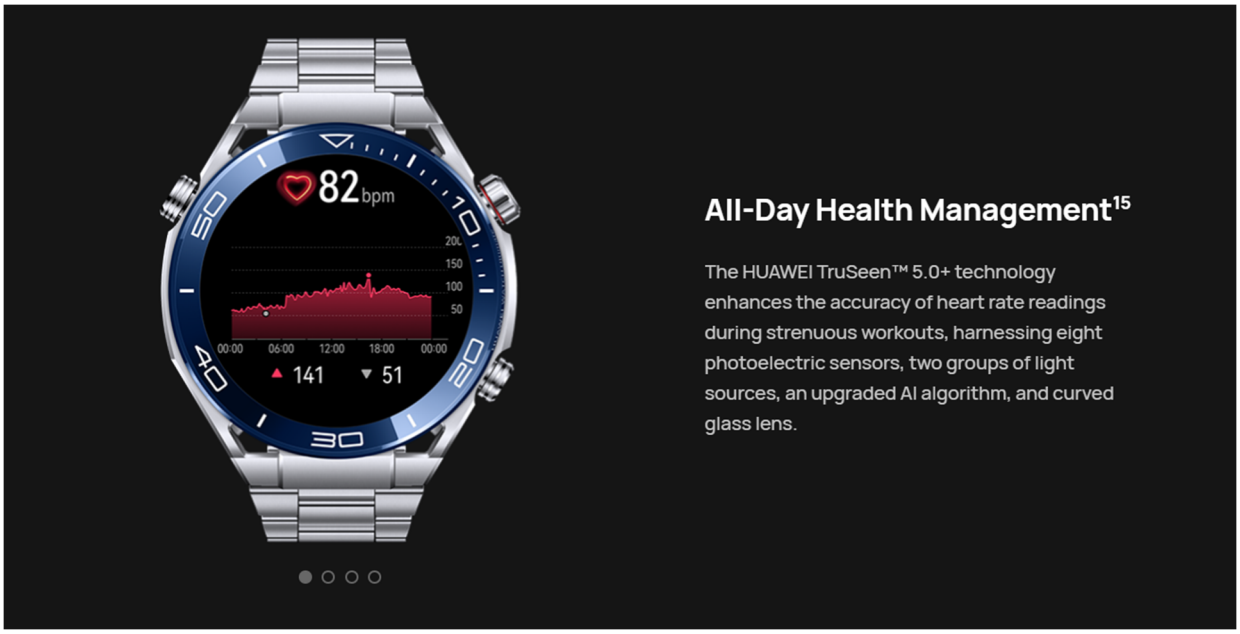




150. On information and belief, the algorithm used by the Accused Watches detects, using the handheld mobile communication device and using only the measurements of one or more physiological parameters, effects of motion artifacts in the measurements of the one or more physiological parameters and deciding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

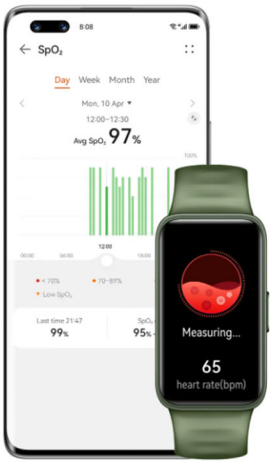
https://consumer.huawei.com/en/wearables/band8/

https://consumer.huawei.com/en/wearables/watch-ultimate/

https://consumer.huawei.com/en/support/content/en-us00733859/

HUAWEI TruSeen™ 5.0

SpO_2 Tracking



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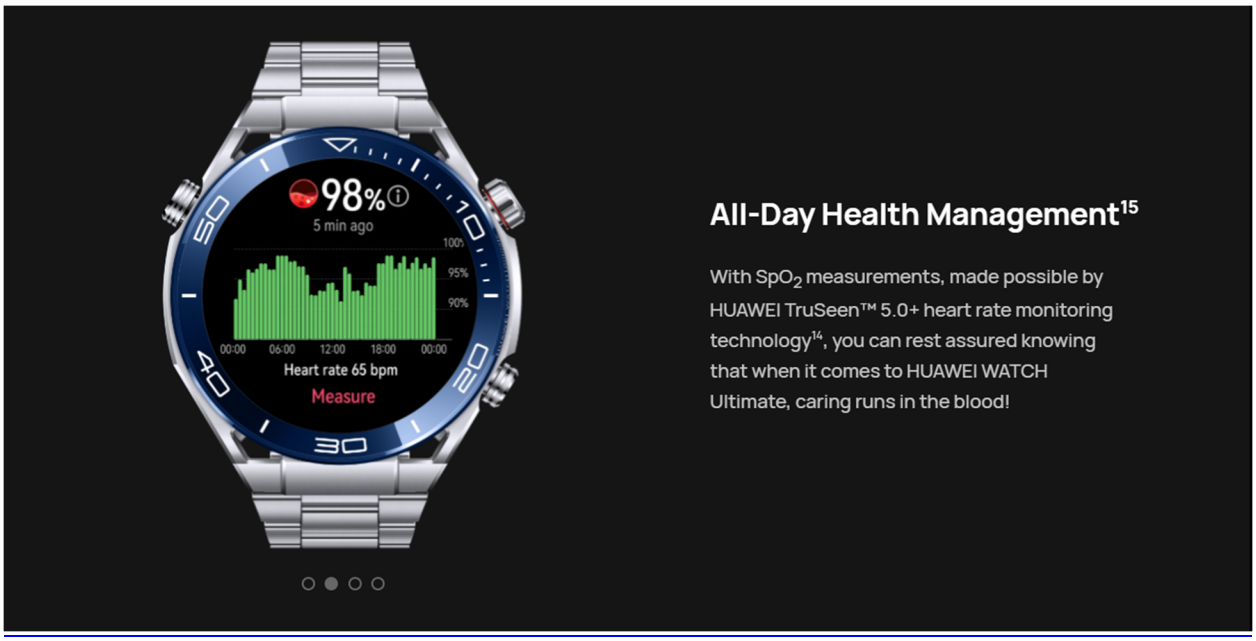
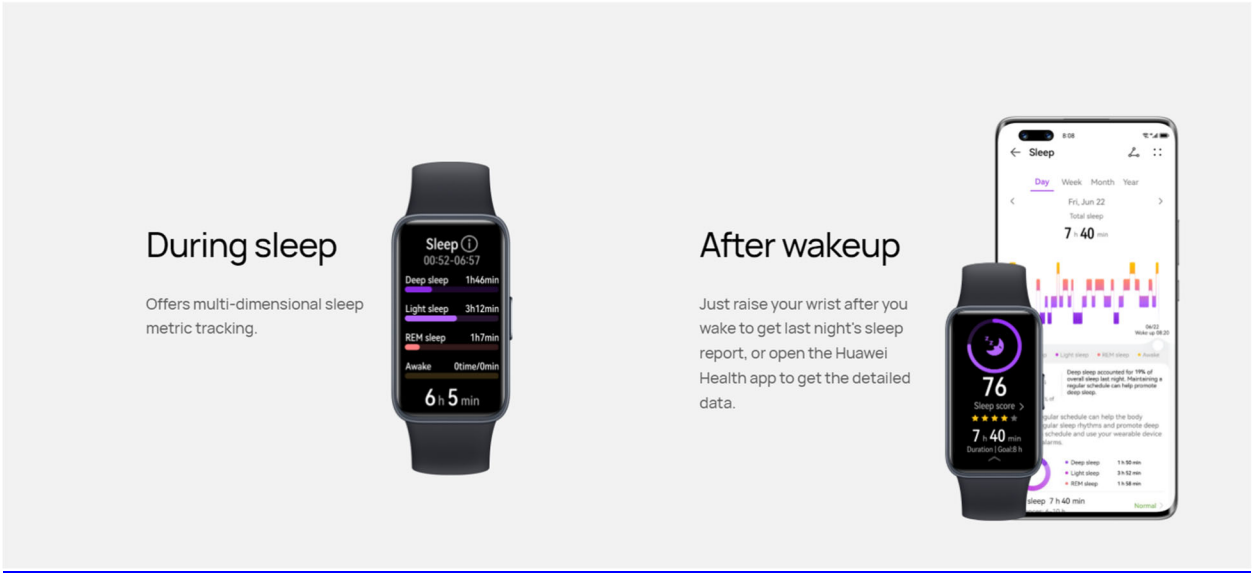
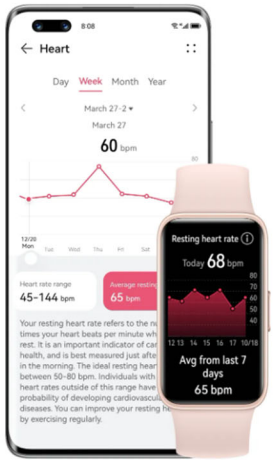

98%
5 min ago
100%
95%
90%
00:00
06:00
12:00
18:00
00:00
Heart rate 65 bpm
Measure
All-Day Health Management[15]
With SpO2 measurements, made possible by HUAWEI TruSeen™ 5.0+ heart rate monitoring technology[14], you can rest assured knowing that when it comes to HUAWEI WATCH Ultimate, caring runs in the blood!


During sleep
Offers multi-dimensional sleep metric tracking.
Sleep
00:52-06:57
Deep sleep 1h46min
Light sleep 3h12min
REM sleep 1h7min
Awake 0time/0min
6h5min
After wakeup
Just raise your wrist after you wake to get last night's sleep report, or open the Huawei Health app to get the detailed data.
Sleep
Day
Week
Month
Year
Fri, Jun 22
Total sleep
7h40min
76
Sleep score
7h40min

HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



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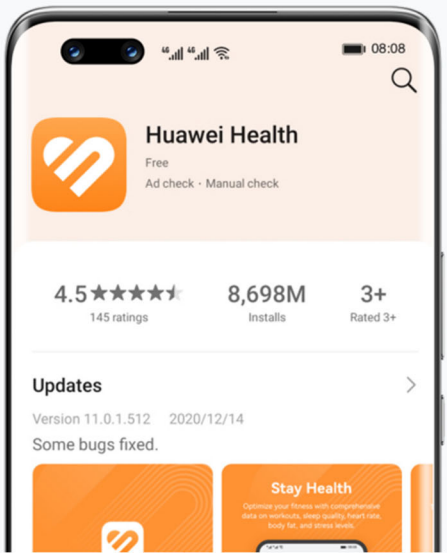

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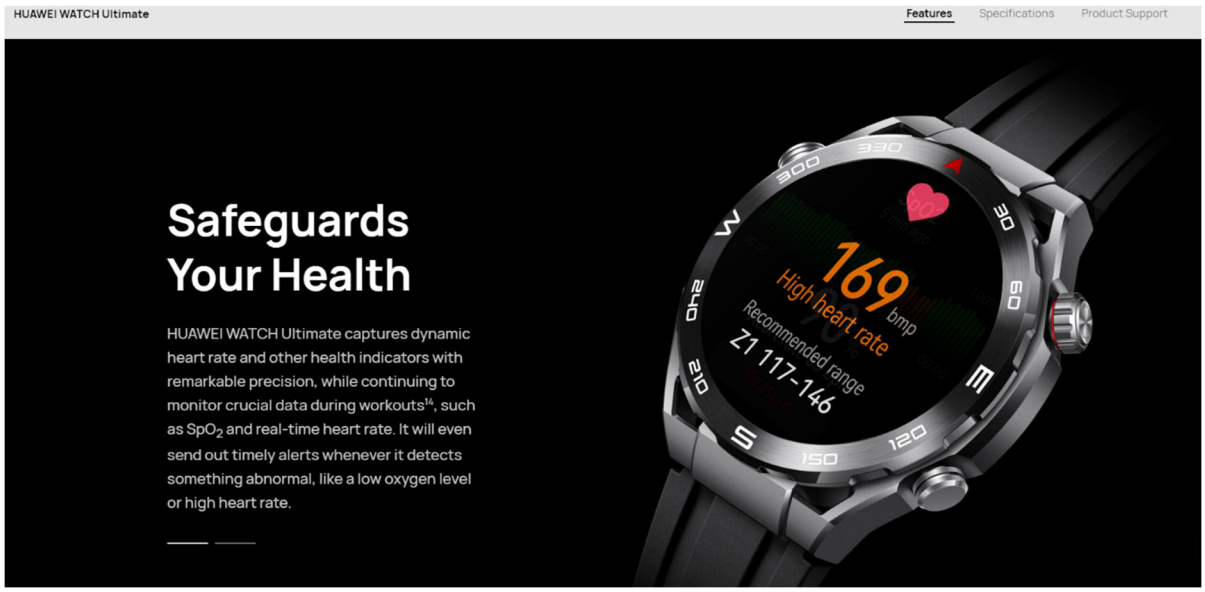
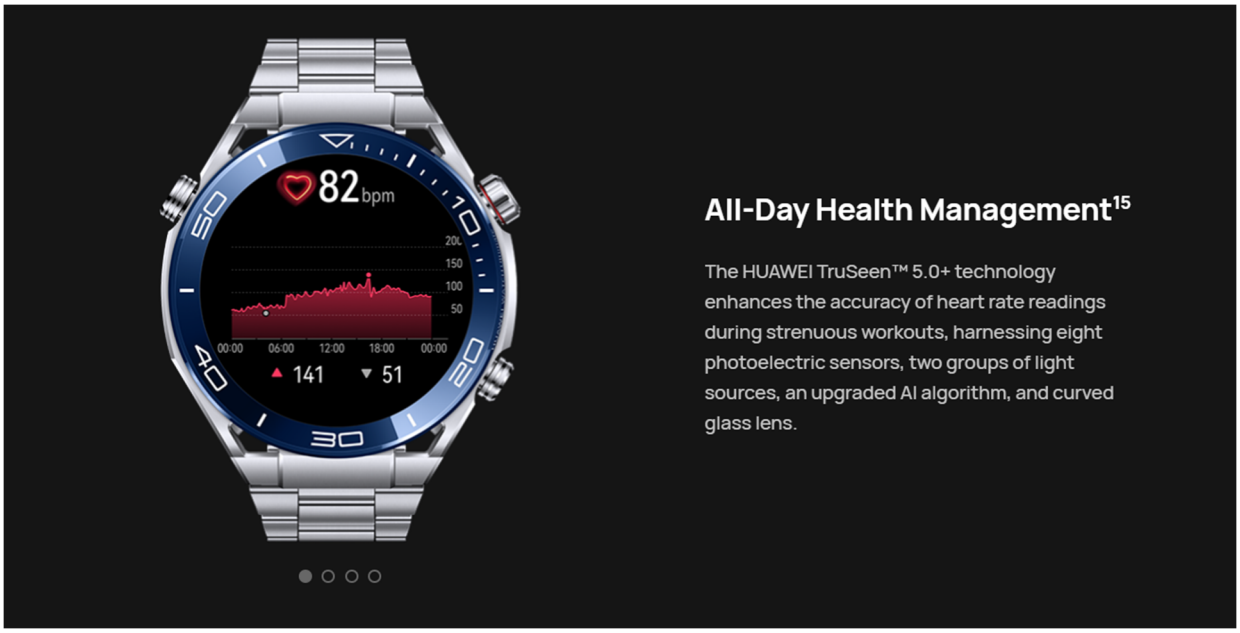

HUAWEI WATCH Ultimate
Features
Specifications
Product Support
Safeguards Your Health
HUAWEI WATCH Ultimate captures dynamic heart rate and other health indicators with remarkable precision, while continuing to monitor crucial data during workouts[14], such as SpO_2 and real-time heart rate. It will even send out timely alerts whenever it detects something abnormal, like a low oxygen level or high heart rate.
169 bmp
High heart rate
Recommended range
71 117-146


82 bpm
141
51
All-Day Health Management[15]
The HUAWEI TruSeen™ 5.0+ technology enhances the accuracy of heart rate readings during strenuous workouts, harnessing eight photoelectric sensors, two groups of light sources, an upgraded AI algorithm, and curved glass lens.

- **Keep a proper wearing habit**
  1. Properly wear your wearable device one-finger width above your wrist bone, with the screen facing upward. Do not wear it too tightly or too loosely, to leave room for your skin to breathe for optimal comfort, and to ensure that the sensor works properly.
  2. Sweat or foreign objects may interfere with the heart rate sensor's ability to receive reflected light, undermining the accuracy of data. In this case, wipe the water or remove the foreign objects from your wrist and the back of your wearable device, and try wearing it again.
- **Inaccurate measurements during workouts**
  1. Tighten the strap before workouts and loosen it after workouts. If you sweat during running, your wearable device may slide on your arm. In this case, wipe off your sweat and slightly tighten the strap, to avoid inaccurate heart rate data.
  2. Heart rate measurements may fluctuate when you engage in exercise that involves frequent changes of pace (such as weight-lifting or basketball). It is recommended that you measure your heart rate during workouts which require a consistent level of effort (such as running, walking, and cycling), in order to obtain more accurate heart rate measurements.
  3. Select the same type of workout as the one you are engaged in. The algorithm has been optimized for different workout types, in order to improve the accuracy of heart rate measurements.
  4. If you are interested in fitness and exercise frequently, it is recommended that you use a soft rubber strap (fluoroelastomer, silicone, or TPU) to ensure optimal contact between your wearable device and your wrist. Leather and metal straps are not suitable for workouts.

151. 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).

152. 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

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

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.

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

154. On information and belief, Huawei had knowledge of Plaintiffs' algorithm and systems as claimed in Claim 1 including from the publication of the '428 patent claims the United States Patent and Trademark Office, but in any event at least as of the filing of this lawsuit.

155. Huawei's infringement of the '428 patent is willful, deliberate, and intentional. On information and belief, Huawei has known of the '428 patent and its infringement of that patent since at least the filing of this Complaint.

156. Because of Huawei's 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.

157. On information and belief, Huawei has 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.

158. Huawei 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.

159. Huawei 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.

160. Huawei 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, Huawei, or an entity under Huawei's direction or control, advertises, offers for sale, and/or otherwise promotes the Accused Watches on its website. Huawei, or one or more related entities, induces retailers and end users. For example, Huawei knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Huawei, or one or more related entities, induces end users by, for example, users of the Accused Watches in its manual to use its Huawei Health app to monitor physiological parameters. Therein, on information and belief, Huawei describes and touts the use of the subject matter claimed in the '428 patent, as described and alleged herein.

161. Plaintiffs reserve the right to assert additional claims of the '428 patent that Huawei infringes.

162. On information and belief, Huawei has known of the existence of the '428 patent and its applicability to the Accused Watches since at least the filing of this Complaint, 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 IV: Infringement of United States Patent No. 9,986,921 by Huawei

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

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

165. On information and belief, Huawei has 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.

166. The above-listed watches are non-limiting. Additional products of Huawei may infringe the '921 patent, and the above-listed watches may infringe additional patents.

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

168. 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.

169. 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://consumer.huawei.com/en/wearables/watch-d/

https://consumer.huawei.com/en/wearables/watch-ultimate/

https://consumer.huawei.com/en/wearables/band8/

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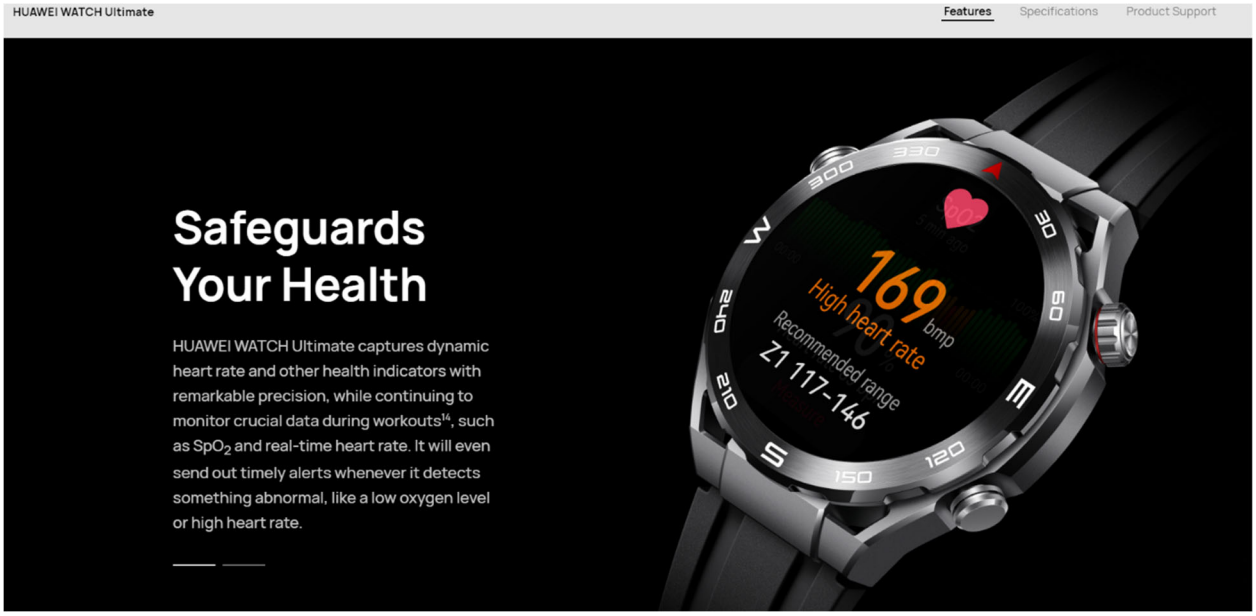

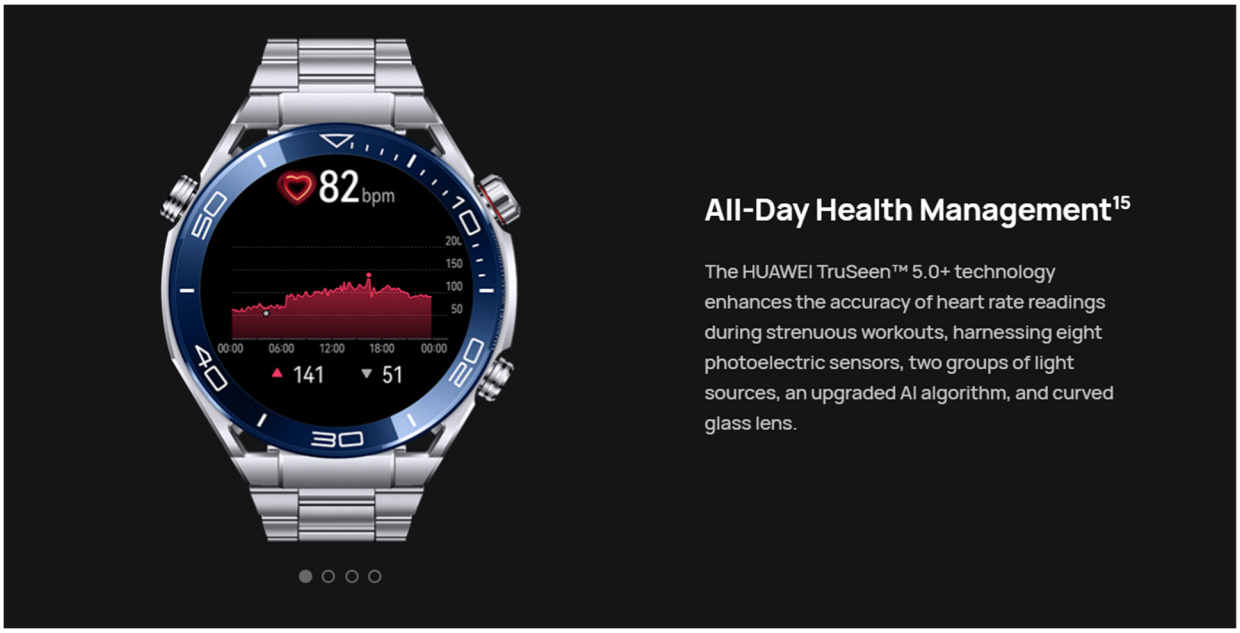

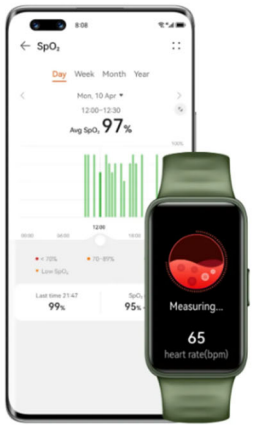

HUAWEI TruSeen™ 5.0

SpO_2 Tracking

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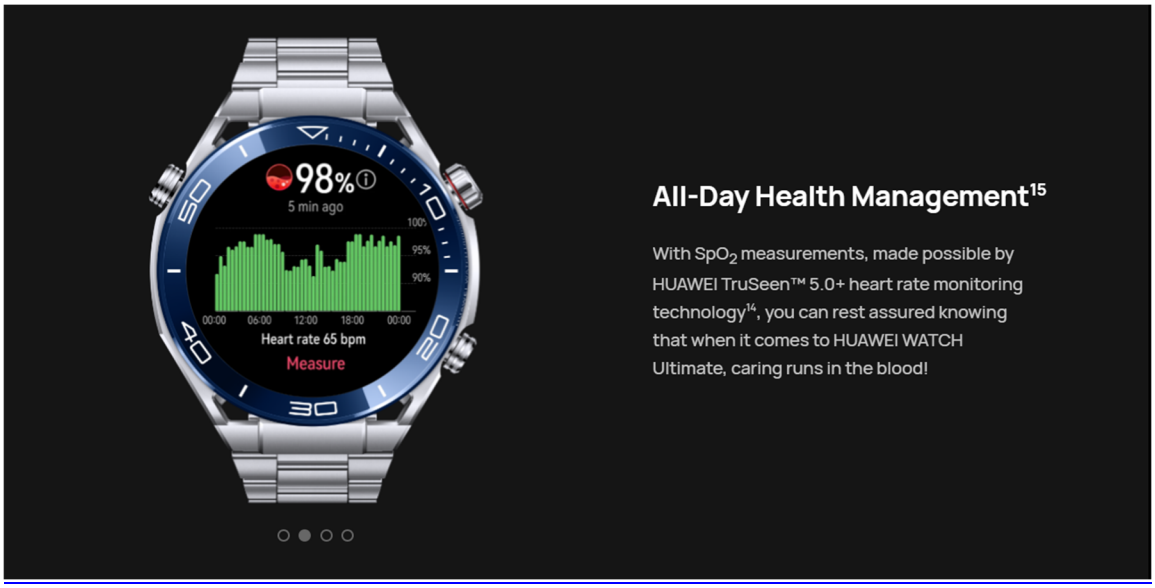
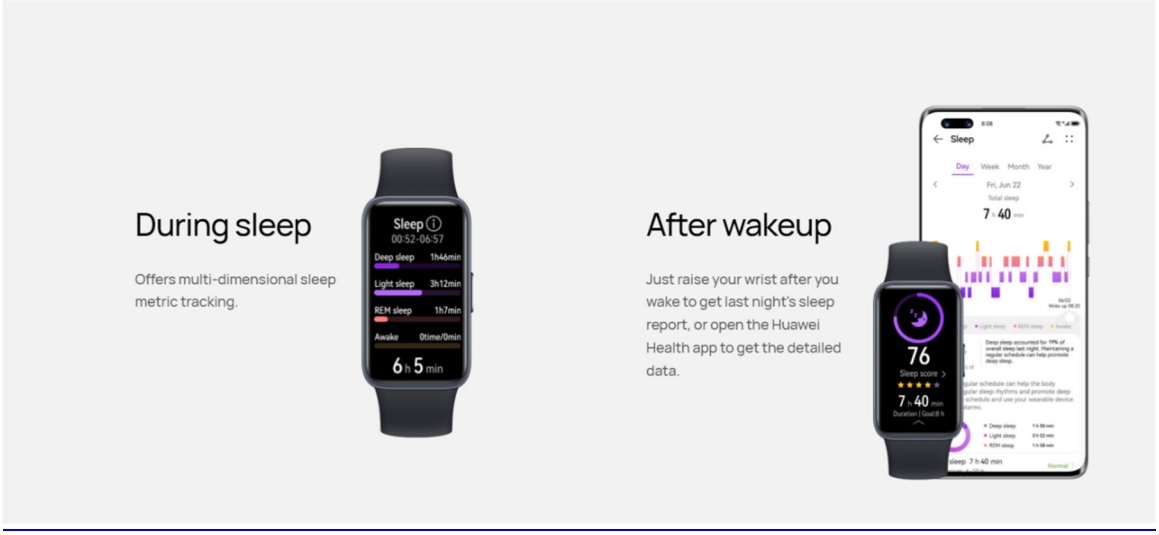

98%
5 min ago
100%
95%
90%
00:00
06:00
12:00
18:00
00:00
Heart rate 65 bpm
Measure
All-Day Health Management[15]
With SpO2 measurements, made possible by HUAWEI TruSeen™ 5.0+ heart rate monitoring technology[14], you can rest assured knowing that when it comes to HUAWEI WATCH Ultimate, caring runs in the blood!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6h 5min
After wakeup
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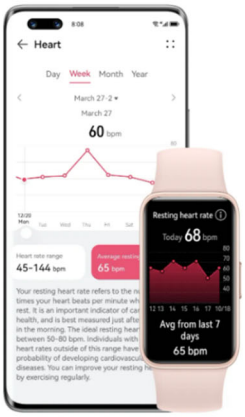
Sleep
Day
Week
Month
Year
7h 40min
76
Sleep score
7h 40min

HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.

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Enhances Your Fitness

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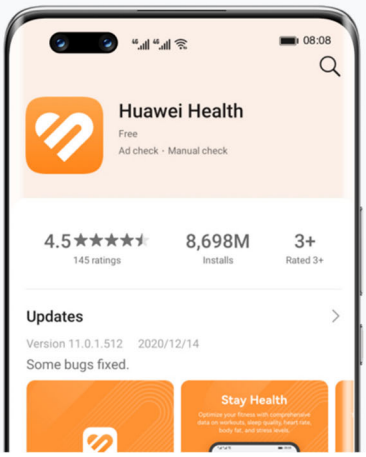
Enrich your training with a pro-level evaluation >



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170. 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.

171. 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.

172. 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.

173. On information and belief, Huawei had knowledge of Plaintiffs' algorithm as claimed in Claim 1 including from the publication of the '921 patent claims the United States Patent and Trademark Office, but in any event at least as of the filing of this lawsuit.

174. Huawei's infringement of the '921 patent is willful, deliberate, and intentional. On information and belief, Huawei has known of the '921 patent and its infringement of the '921 patent since at least the filing of this Complaint.

175. Because of Huawei's 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.

176. On information and belief, Huawei has 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.

177. Huawei 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.

178. Huawei 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.

179. Huawei 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, Huawei knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally,

Huawei, or one or more related entities, induces end users by, for example, users of the Accused Watches in its manual to use its Huawei Health app to monitor physiological parameters. Therein, on information and belief, Huawei describes and touts the use of the subject matter claimed in the '921 patent, as described and alleged herein.

180. Plaintiffs reserve the right to assert additional claims of the '921 patent that Huawei infringes.

181. On information and belief, Huawei has known of the existence of the '921 patent and its applicability to the Accused Watches since at least the filing of this Complaint, 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 V: Infringement of United States Patent No. 10,278,647 by Huawei

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

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

184. On information and belief, Huawei has 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.

185. The above-listed watches are non-limiting. Additional products of Huawei may infringe the '647 patent, and the above-listed watches may infringe additional patents.

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

187. 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.

188. 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://consumer.huawei.com/en/wearables/watch-d/

https://consumer.huawei.com/en/wearables/watch-ultimate/

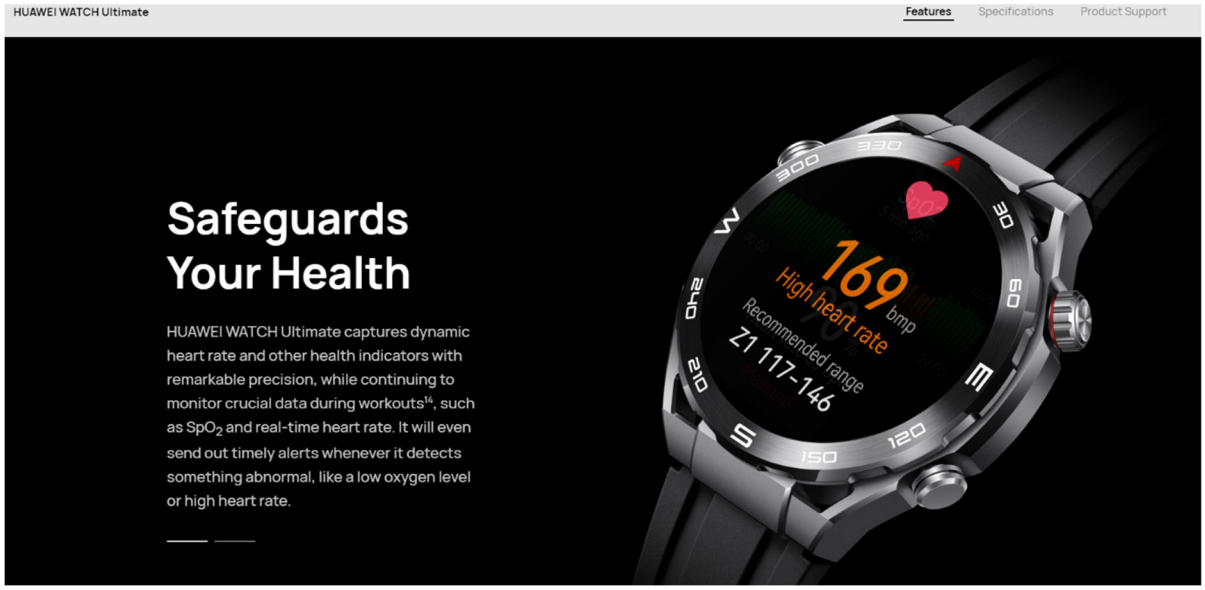
https://consumer.huawei.com/en/support/content/en-us00733859/

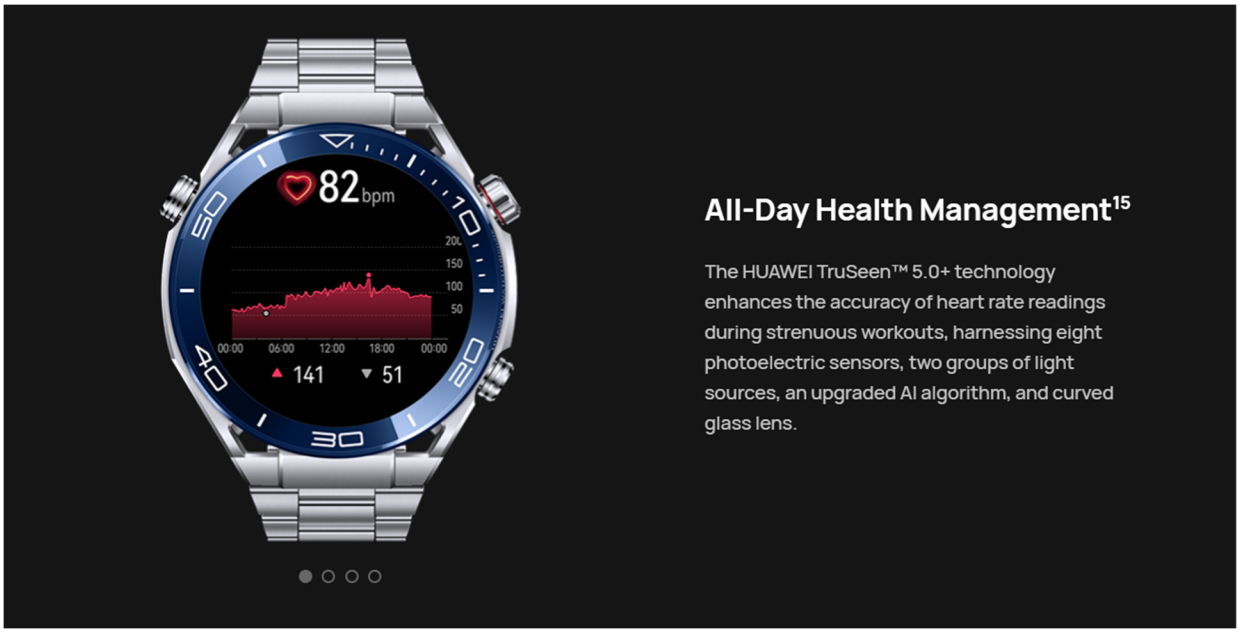
https://consumer.huawei.com/en/wearables/band8/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.


HUAWEI


HUAWEI WATCH Ultimate
Features
Specifications
Product Support
Safeguards Your Health
HUAWEI WATCH Ultimate captures dynamic heart rate and other health indicators with remarkable precision, while continuing to monitor crucial data during workouts[14], such as SpO_2 and real-time heart rate. It will even send out timely alerts whenever it detects something abnormal, like a low oxygen level or high heart rate.
169 bmp
High heart rate
Recommended range
Z1 117-146

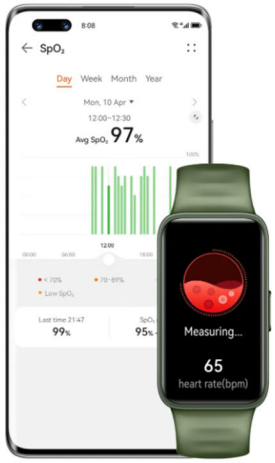


How does the wearable device measure your heart rate

Your heart rate is measured with the optical heart rate sensor on the back of your wearable device, which measures the blood flow changes in your wrist by emitting light into your skin, and detecting how much the light is reflected back.

HUAWEI TruSeen™ 5.0

SpO_2 Tracking



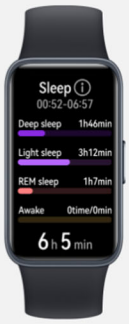
Smart TruSeen™ 5.0 capabilities allow the band to automatically track your SpO_2 level[7], and notify you immediately if it ever drops below the ideal range, so that you can get back to feel good in no time.

All-Day Health Management[15]

With SpO_2 measurements, made possible by HUAWEI TruSeen™ 5.0+ heart rate monitoring technology[14], you can rest assured knowing that when it comes to HUAWEI WATCH Ultimate, caring runs in the blood!

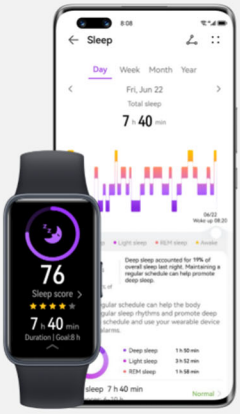
During sleep

Offers multi-dimensional sleep metric tracking.



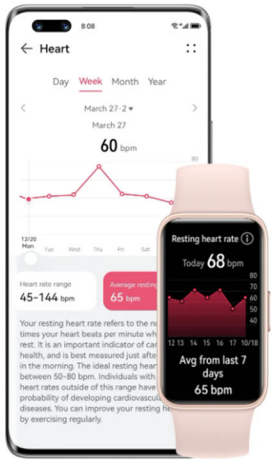
After wakeup

Just raise your wrist after you wake to get last night's sleep report, or open the Huawei Health app to get the detailed data.



HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



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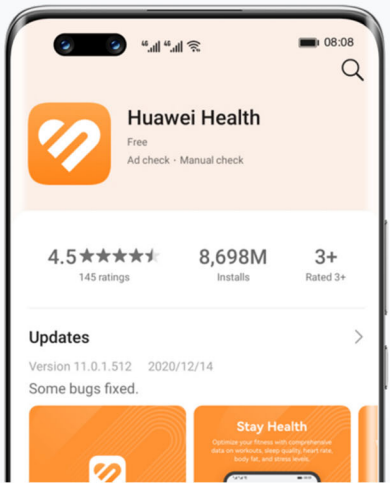

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189. On information and belief, the algorithm used by the Accused Watches reconstructs a representation of the heart-related signal to produce a reconstructed representation of the heart-related signal, the reconstructing based on (i) a time-varying 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, as shown below.

https://consumer.huawei.com/en/wearables/watch-d/

https://consumer.huawei.com/en/wearables/watch-ultimate/

https://consumer.huawei.com/en/wearables/band8/

https://consumer.huawei.com/en/support/content/en-us00733859/

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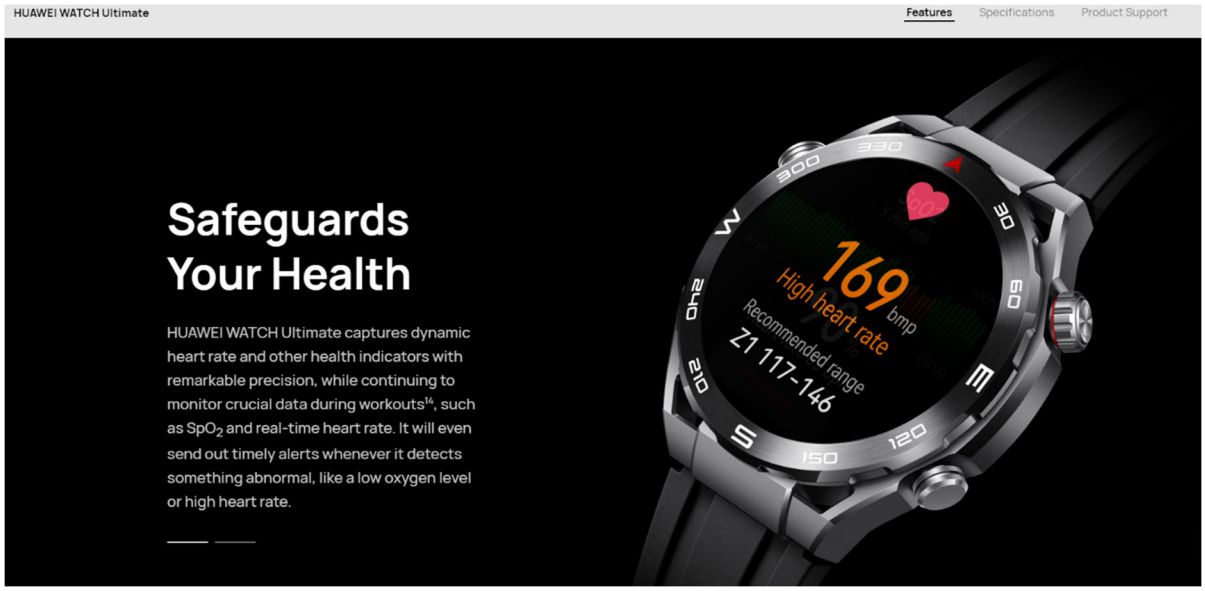

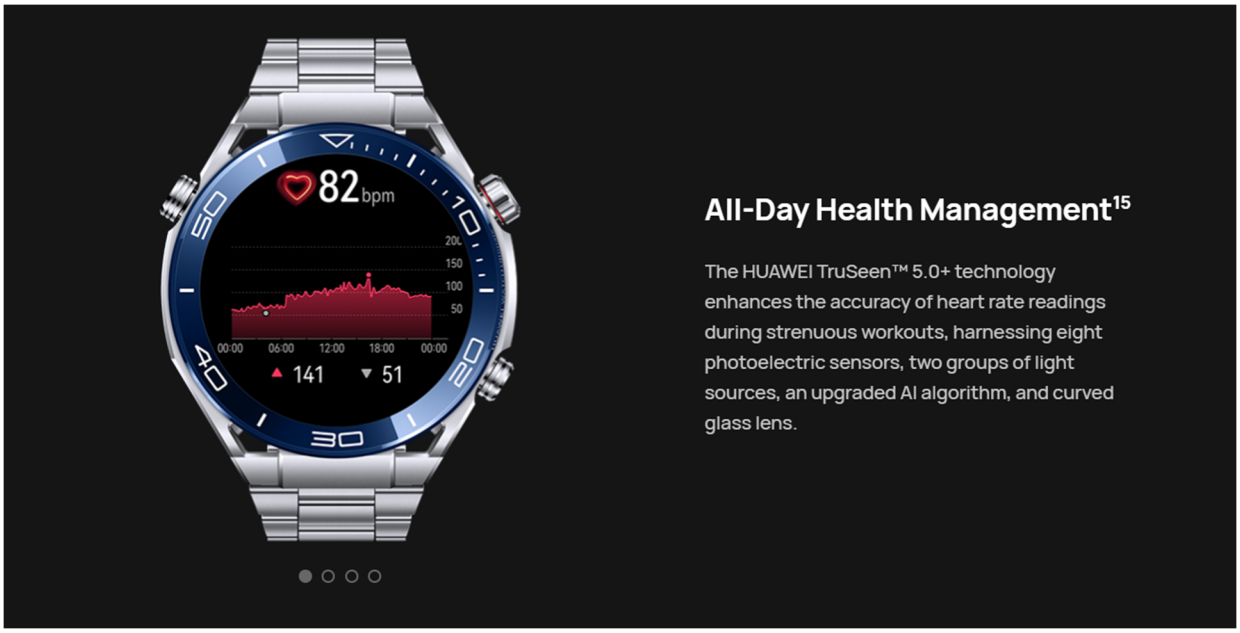

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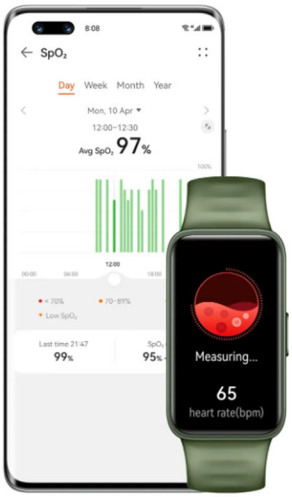
HUAWEI TruSeen™ 5.0

SpO_2 Tracking



Smart TruSeen™ 5.0 capabilities allow the band to automatically track your SpO_2 level[7], and notify you immediately if it ever drops below the ideal range, so that you can get back to feel good in no time.

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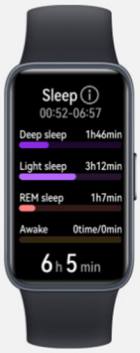

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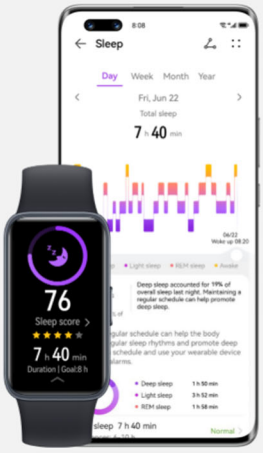
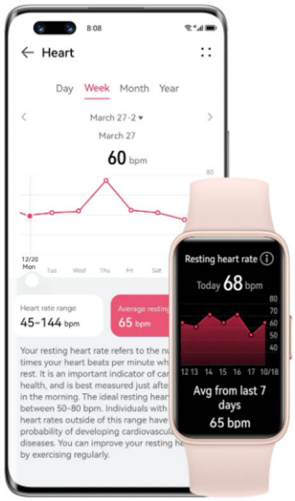


HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



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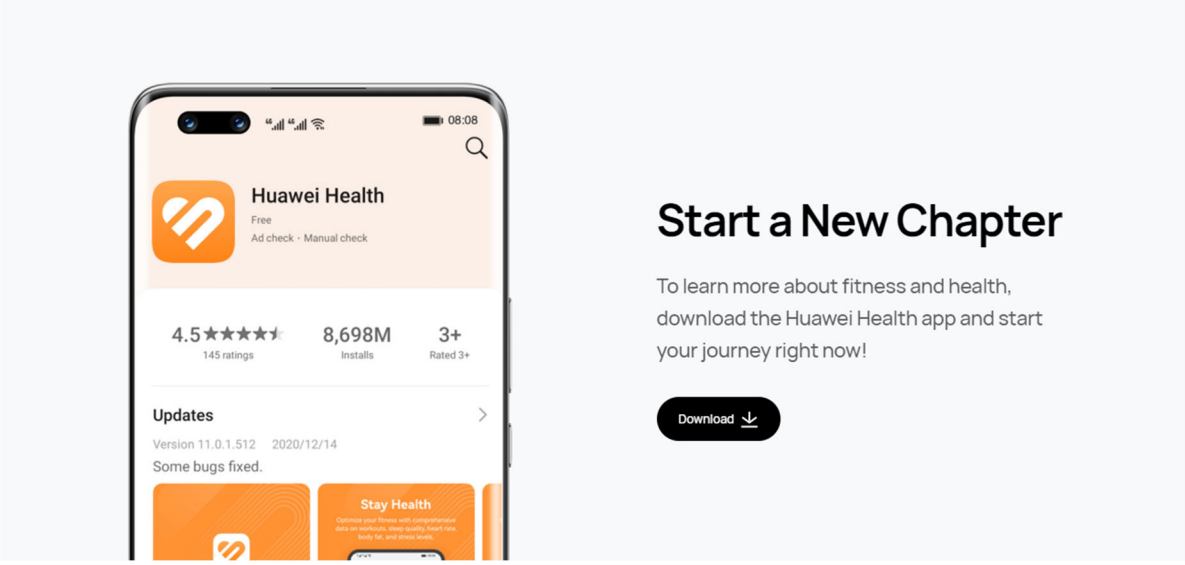


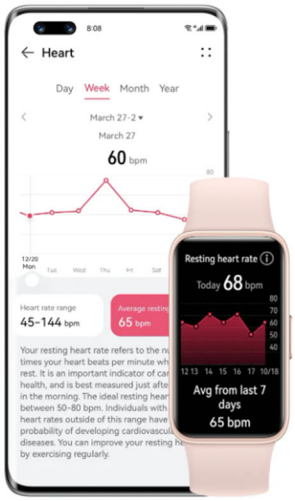
- **Keep a proper wearing habit**
  1. Properly wear your wearable device one-finger width above your wrist bone, with the screen facing upward. Do not wear it too tightly or too loosely, to leave room for your skin to breathe for optimal comfort, and to ensure that the sensor works properly.
  2. Sweat or foreign objects may interfere with the heart rate sensor's ability to receive reflected light, undermining the accuracy of data. In this case, wipe the water or remove the foreign objects from your wrist and the back of your wearable device, and try wearing it again.
- **Inaccurate measurements during workouts**
  1. Tighten the strap before workouts and loosen it after workouts. If you sweat during running, your wearable device may slide on your arm. In this case, wipe off your sweat and slightly tighten the strap, to avoid inaccurate heart rate data.
  2. Heart rate measurements may fluctuate when you engage in exercise that involves frequent changes of pace (such as weight-lifting or basketball). It is recommended that you measure your heart rate during workouts which require a consistent level of effort (such as running, walking, and cycling), in order to obtain more accurate heart rate measurements.
  3. Select the same type of workout as the one you are engaged in. The algorithm has been optimized for different workout types, in order to improve the accuracy of heart rate measurements.
  4. If you are interested in fitness and exercise frequently, it is recommended that you use a soft rubber strap (fluoroelastomer, silicone, or TPU) to ensure optimal contact between your wearable device and your wrist. Leather and metal straps are not suitable for workouts.

190. 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://consumer.huawei.com/en/wearables/band8/

HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



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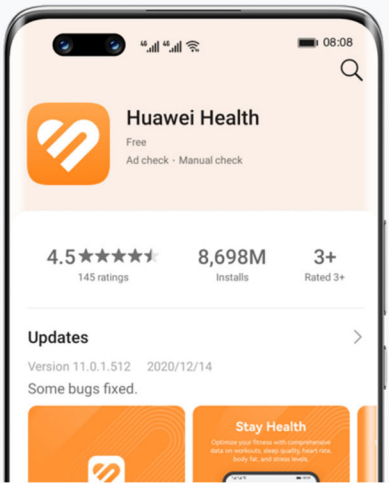

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191. On information and belief, Huawei had knowledge of Plaintiffs' algorithm as claimed in Claim 1 including from the publication of the '647 patent claims the

United States Patent and Trademark Office, but in any event at least as of the filing of this lawsuit.

192. Huawei's infringement of the '647 patent is willful, deliberate, and intentional. On information and belief, Huawei has known of the '647 patent and its infringement of that patent since at least the filing of this Complaint.

193. Because of Huawei's 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.

194. On information and belief, Huawei has 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.

195. Huawei 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.

196. Huawei 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.

197. Huawei 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, Huawei knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Huawei, or one or more related entities, induces end users by, for example, users of the Accused Watches in its manual to use its Huawei Health app to monitor physiological parameters. Therein, on information and belief, Huawei describes and touts the use of the subject matter claimed in the '647 patent, as described and alleged herein.

198. Plaintiffs reserve the right to assert additional claims of the '647 patent that Huawei infringes.

199. On information and belief, Huawei has known of the existence of the '647 patent and its applicability to the Accused Watches since at least the filing of this Complaint, 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 VI: Infringement of United States Patent No. 10,285,601 by Huawei

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

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

202. On information and belief, Huawei has 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.

203. The above-listed watches are non-limiting. Additional products of Huawei may infringe the '601 patent, and the above-listed watches may infringe additional patents.

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

205. 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.

206. 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://consumer.huawei.com/en/wearables/watch-d/

https://consumer.huawei.com/en/wearables/watch-ultimate/

https://consumer.huawei.com/en/support/content/en-us00733859/

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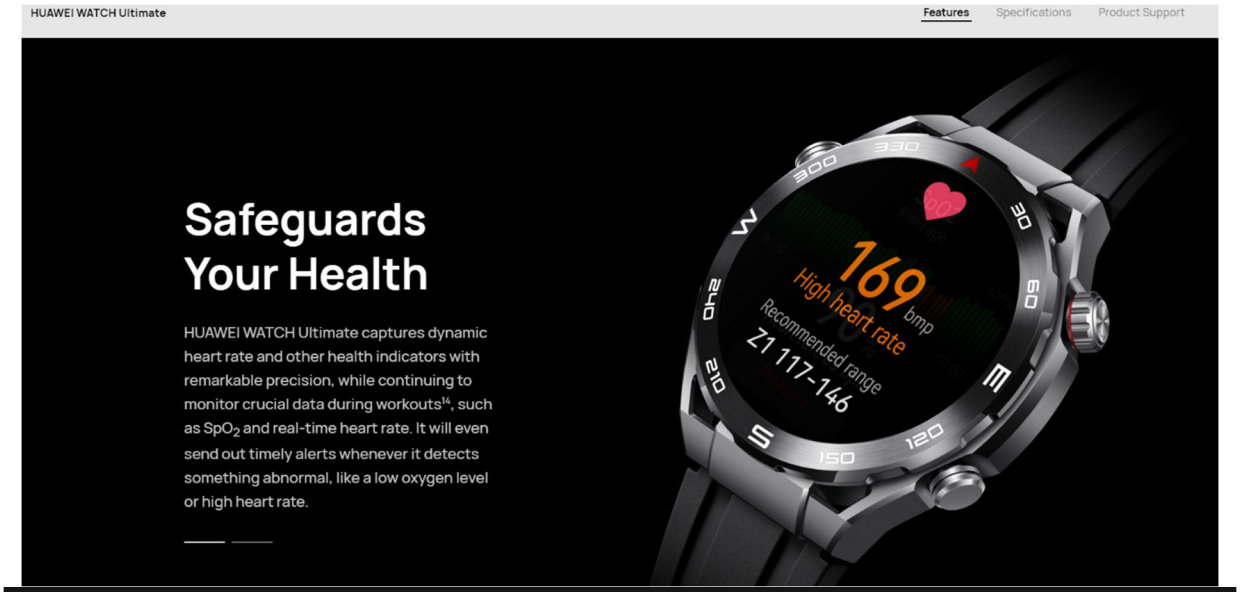

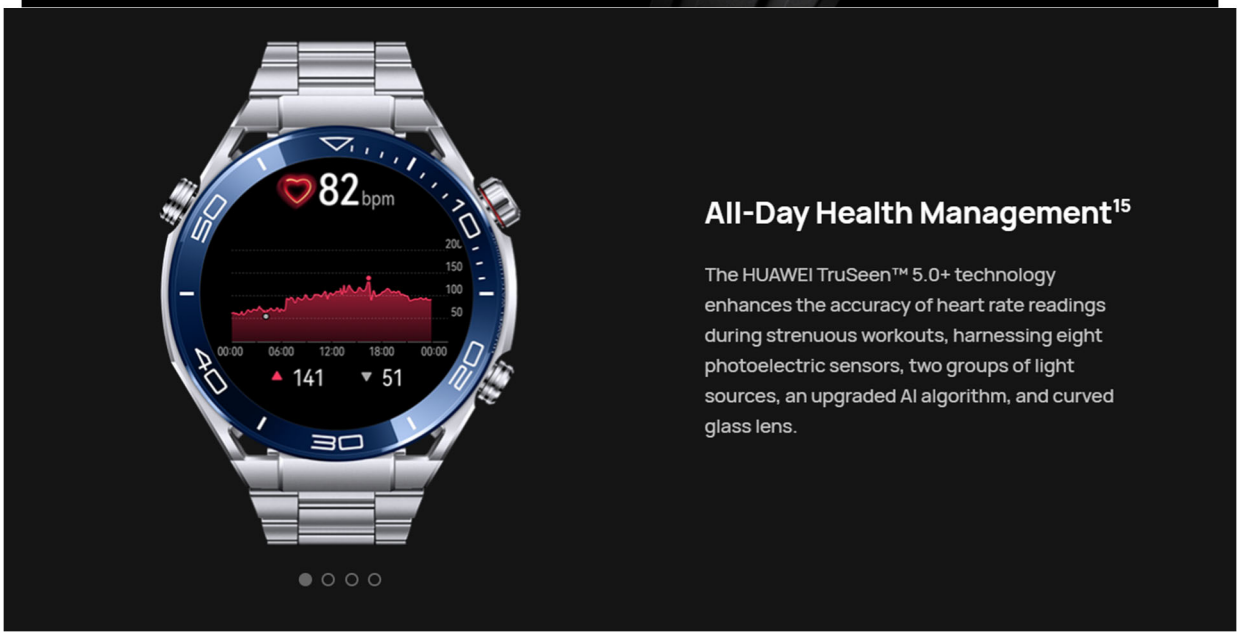

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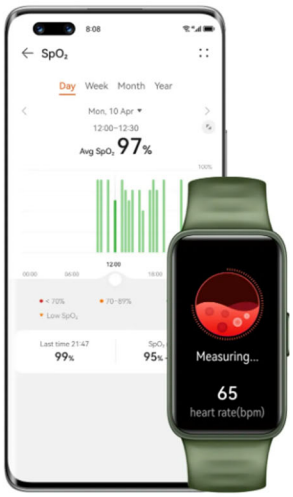
HUAWEI TruSeen™ 5.0

SpO_2 Tracking



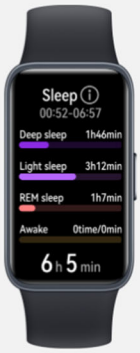
Smart TruSeen™ 5.0 capabilities allow the band to automatically track your SpO_2 level[7], and notify you immediately if it ever drops below the ideal range, so that you can get back to feel good in no time.

All-Day Health Management[15]

With SpO_2 measurements, made possible by HUAWEI TruSeen™ 5.0+ heart rate monitoring technology[14], you can rest assured knowing that when it comes to HUAWEI WATCH Ultimate, caring runs in the blood!

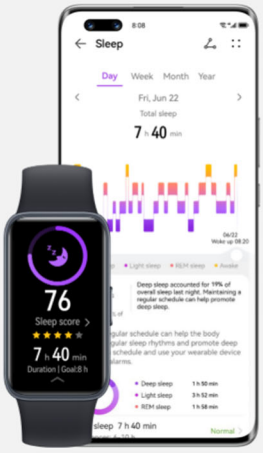
During sleep

Offers multi-dimensional sleep metric tracking.



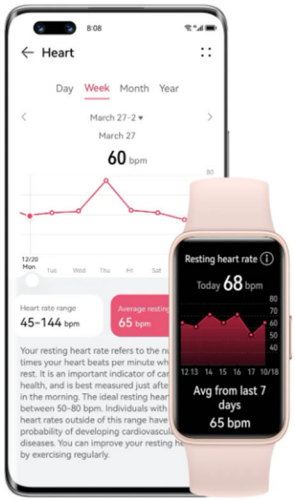
After wakeup

Just raise your wrist after you wake to get last night's sleep report, or open the Huawei Health app to get the detailed data.



HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



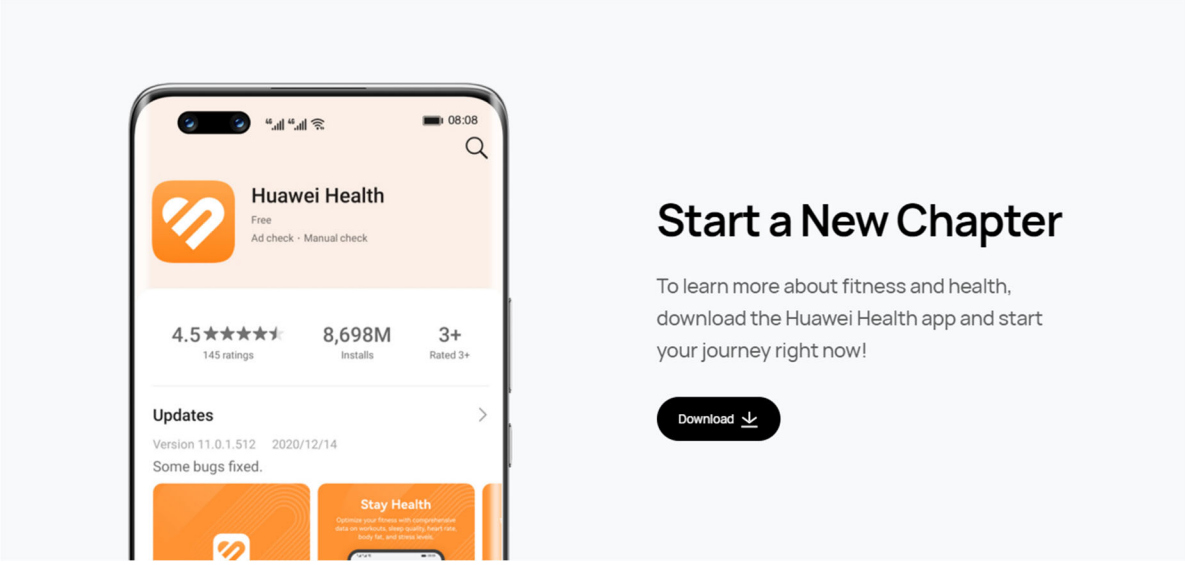
HUAWEI Band 8 features a new and improved AI algorithm that tracks heart rate round the clock and tells you right away if something is abnormal[8]. The system shows you your resting heart rate data for the past 7 days in intuitive graphs, and provides healthy heart rate zones and upper limit reminders during workouts.

HUAWEI TruSport™

Enhances Your Fitness

100 band-tastic workout* modes[9] are here for you to choose from. The band will even recognise when you're running and walking, and automatically detect any of the four major swimming strokes, as well as provide real-time heart rate monitoring during swimming. You can even get rewarded with a wealth of wondrous data, including running ability index (RAI), weekly training load, recovery, and VO_2Max[10] with TruSport™ system support. AI running plan in HUAWEI Health app helps you get the most out of every step or stride.

Enrich your training with a pro-level evaluation >



207. The algorithm and technology used by the Accused Watches have one or more processors.

208. 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.

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

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

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

212. 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.

213. 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.

214. On information and belief, Huawei had knowledge of Plaintiffs' algorithm and systems as claimed in Claim 1 including from the publication of the '601 patent claims the United States Patent and Trademark Office, but in any event at least as of the filing of this lawsuit.

215. Huawei's infringement of the '601 patent is willful, deliberate, and intentional. On information and belief, Huawei has known of the '601 patent and its infringement of that patent since at least the filing of this Complaint.

216. Because of Huawei's 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.

217. On information and belief, Huawei has 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.

218. Huawei 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.

219. Huawei 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.

220. Huawei 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, Huawei knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Huawei, or one or more related entities, induces end users by, for example, users of the Accused Watches in its manual to use its Huawei Health app to monitor physiological parameters. Therein, on information and belief, Huawei describes and touts the use of the subject matter claimed in the '601 patent, as described and alleged herein.

221. Plaintiffs reserve the right to assert additional claims of the '601 patent that Huawei infringes.

222. On information and belief, Huawei has known of the existence of the '601 patent and its applicability to the Accused Watches since at least the filing of the Complaint, 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 VII: Infringement of United States Patent No. 10,653,362 by Huawei

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

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

225. On information and belief, Huawei has 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.

226. The above-listed watches are non-limiting. Additional products of Huawei may infringe the '362 patent, and the above-listed watches may infringe additional patents.

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

228. 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.

229. 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://consumer.huawei.com/en/wearables/watch-d/

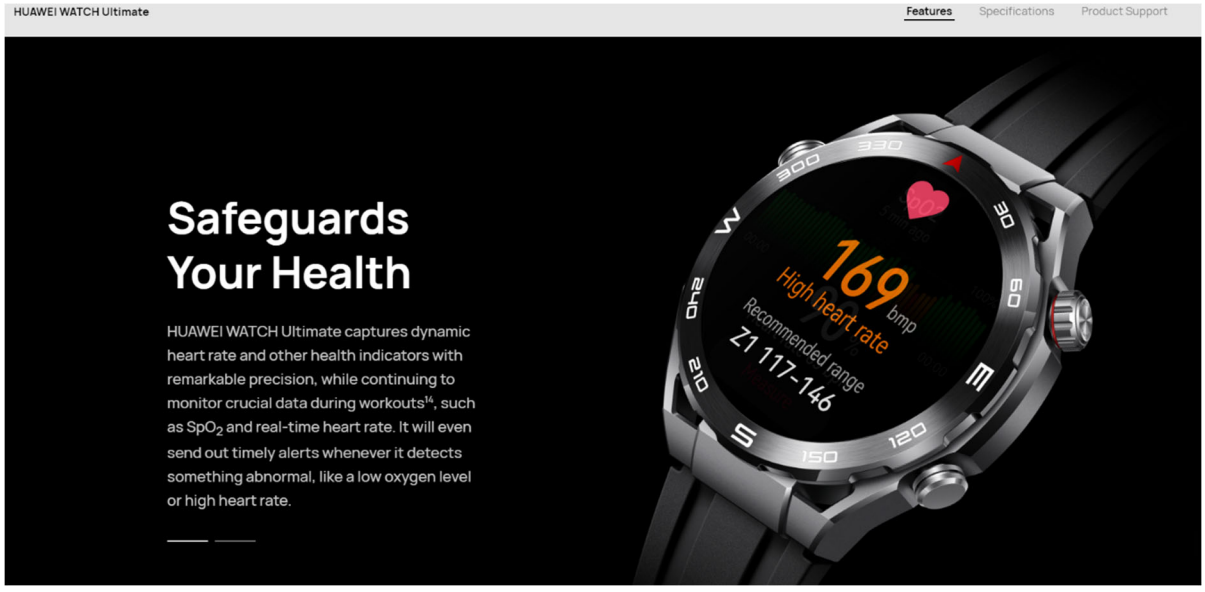
https://consumer.huawei.com/en/wearables/watch-ultimate/

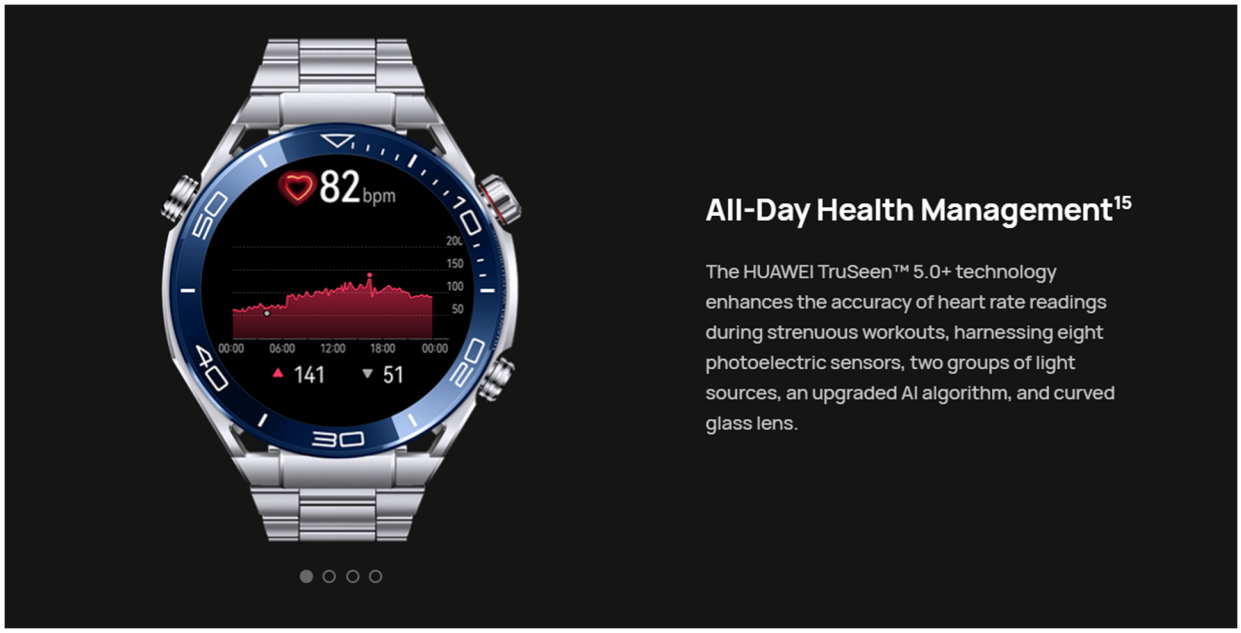
https://consumer.huawei.com/en/wearables/band8/

HUAWEI TruSeen™ 5.0+ Heart Rate Monitoring

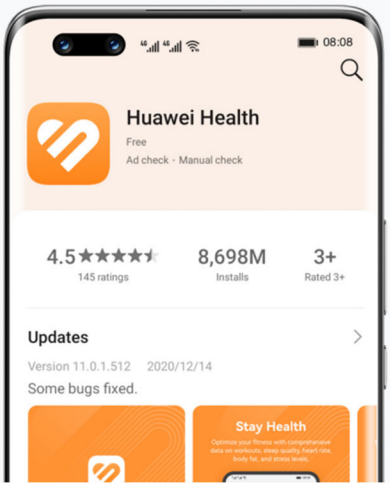
HUAWEI TruSeen™ 5.0+ heart rate monitoring technology deploys eight photoelectric sensors deployed in a ring formation, with two groups of light sources, to boost anti-interference capabilities by converging different signals. The watch's ergonomic sapphire rear case curves gracefully around the wrist, while substantially reducing light interference. An updated algorithm tracks heart rate with greater precision via high-fidelity signal processing, with PVD-coated electrodes[6] to provide a comfortable, skin-tight fit, for enhanced ECG readings.


HUAWEI


HUAWEI WATCH Ultimate
Features
Specifications
Product Support
Safeguards Your Health
HUAWEI WATCH Ultimate captures dynamic heart rate and other health indicators with remarkable precision, while continuing to monitor crucial data during workouts[14], such as SpO_2 and real-time heart rate. It will even send out timely alerts whenever it detects something abnormal, like a low oxygen level or high heart rate.
169 bmp
High heart rate
Recommended range
Z1 117-146


82 bpm
141
51
All-Day Health Management[15]
The HUAWEI TruSeen™ 5.0+ technology enhances the accuracy of heart rate readings during strenuous workouts, harnessing eight photoelectric sensors, two groups of light sources, an upgraded AI algorithm, and curved glass lens.


7645
10:08
328
Compatible with More Devices
HUAWEI Band 8 works seamlessly with both iOS and Android smartphones[3].



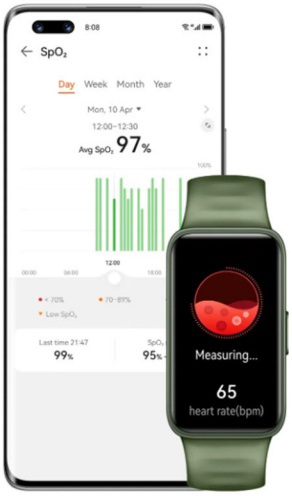
Start a New Chapter

To learn more about fitness and health, download the Huawei Health app and start your journey right now!

Download

HUAWEI TruSeen™ 5.0

SpO_2 Tracking



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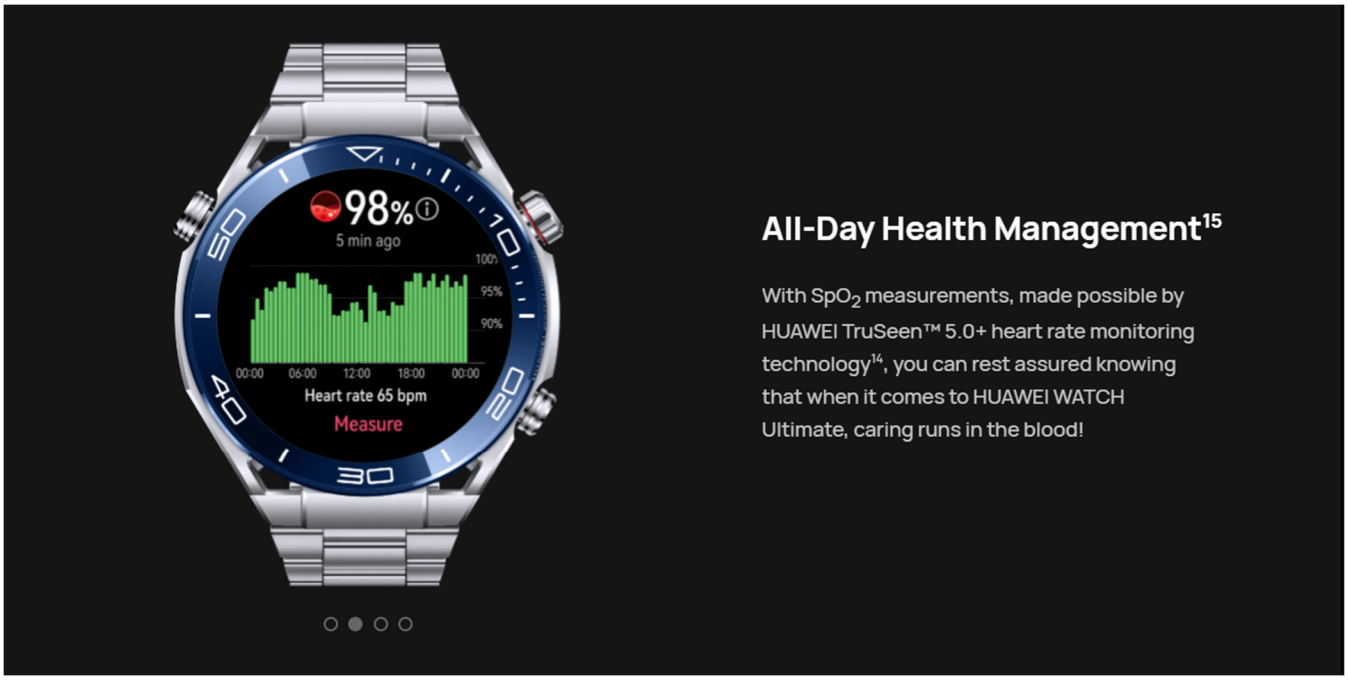

All-Day Health Management[15]

With SpO_2 measurements, made possible by HUAWEI TruSeen™ 5.0+ heart rate monitoring technology[14], you can rest assured knowing that when it comes to HUAWEI WATCH Ultimate, caring runs in the blood!

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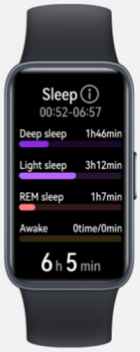
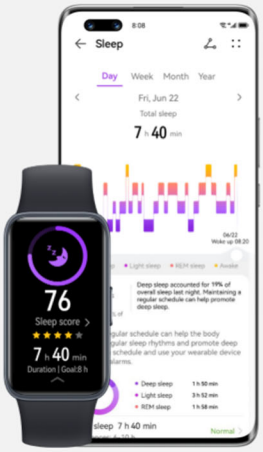
Offers multi-dimensional sleep metric tracking.



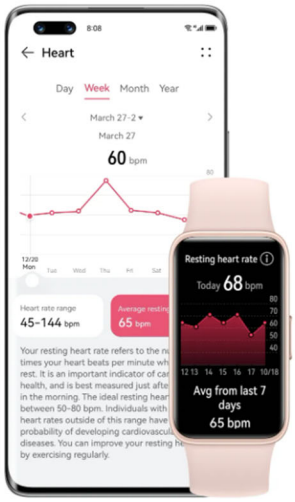
After wakeup

Just raise your wrist after you wake to get last night's sleep report, or open the Huawei Health app to get the detailed data.



HUAWEI TruSeen™ 5.0

Wear Your Heart on Your Sleeve



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Enrich your training with a pro-level evaluation >

230. 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.

231. 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.

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

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

234. 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.

235. 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.

236. 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.

237. 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.

238. 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.

239. 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.

240. 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.

241. 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.

242. 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.

243. On information and belief, Huawei had knowledge of Plaintiffs' algorithm and apparatus as claimed in Claim 1 including from the publication of the '362 patent claims the United States Patent and Trademark Office, but in any event at least as of the filing of this lawsuit.

244. Huawei's infringement of the '362 patent is willful, deliberate, and intentional. On information and belief, Huawei has known about the '362 patent and its infringement of that patent since at least the filing of the Complaint.

245. Because of Huawei's 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.

246. On information and belief, Huawei has 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.

247. Huawei 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.

248. Huawei 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.

249. Huawei 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, Huawei knowingly and intentionally induces retailers to advertise, offer for sale, and/or otherwise promote the Accused Watches on their websites and in stores. Additionally, Huawei, or one or more related entities, induces end users by, for example, instructing in its manual users of the Accused Watches to use its Huawei Health app to monitor physiological parameters. Therein, on information and belief, Huawei describes and touts the use of the subject matter claimed in the '362 patent, as described and alleged herein.

250. Plaintiffs reserve the right to assert additional claims of the '362 patent that Huawei infringes.

251. On information and belief, Huawei has known of the existence of the '362 patent and its applicability to the Accused Watches since at least the filing of the Complaint, 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 Defendant as follows:

a. finding that Defendant has 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: November 22, 2023

Respectfully submitted,

/s/ Michael A. Siem by permission Claire Abernathy Henry
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(pro hac vice forthcoming)
Cedric Tan
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