



Accurate biometrics.
Industry experts.
Complete solutions.

We make it work.





VALENCCELL

Valencell transforms the science of wearable biometrics to enable impactful health outcomes.

Through our innovative R&D and validated technologies, we develop breakthroughs and collaborate with wearables, hearables, and medical device companies around the world to deliver amazing results.

Valencell is the company that 1st made PPG truly wearable and suitable for virtually any activity and form-factor

PPG before Valencell

- Accurate only in hospitals or low activity settings
- Didn't work outdoors (sunlight contamination)
- Not part of what people already wear



PPG after Valencell

- Accurate during virtually any activity
- Accurate indoors and outdoors
- Integrated within popular consumer form-factors

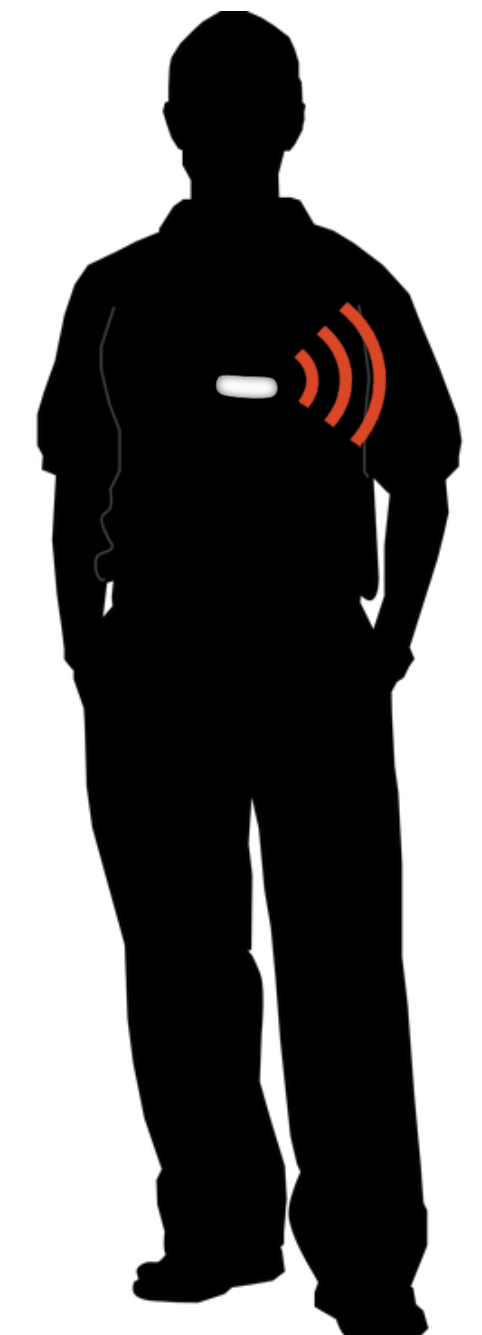
Hearables



Wrist Devices



Armbands/Patches



Valencell Overview



- Founded in 2006
- Turn-key biometric sensor system includes hardware, software, testing & validation; widely recognized as the most accurate technology available today
- Valencell powers more biometric wearable products than any others in the market today
- World-class biometric testing lab that tests, validates, and optimizes our customer's products
- A diverse team of data scientists focused on R&D, exploring and developing new models that enable impactful health outcomes
- Over 80 patents granted and 100+ pending that are the most cited patent portfolio in wearable PPG
- Strategic partnership with Sonion a/s to make biometric universal in earbuds and hearing health devices
- Robust product pipeline with next-gen biometrics, such as respiration rate, sleep metrics, stress metrics, blood pressure, & more

Valencell provides biometric sensor systems for more wearables than any other company in the world



- Embedded in >50 biometric wearables in market
- We work with companies of all sizes
- Multiple form factors & use cases

Valencell enables a wide range of biometric devices

Wearables



Health/Medical Devices



Industrial, Military



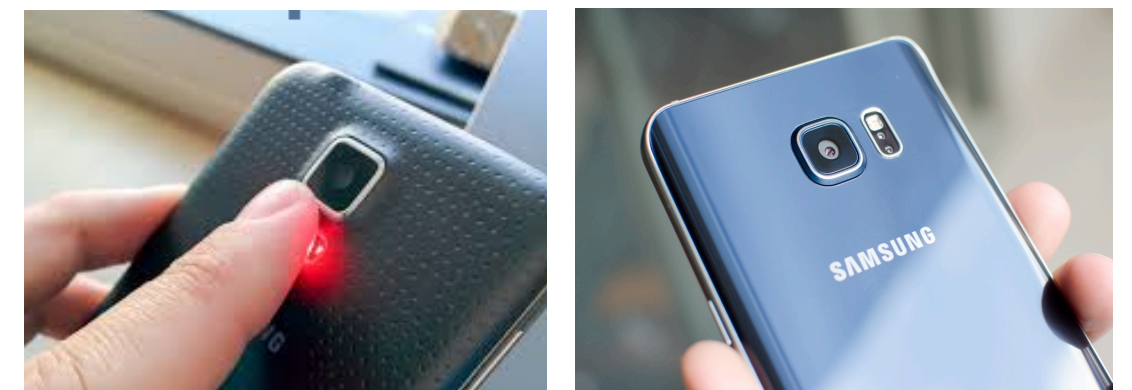
AR/VR Headsets



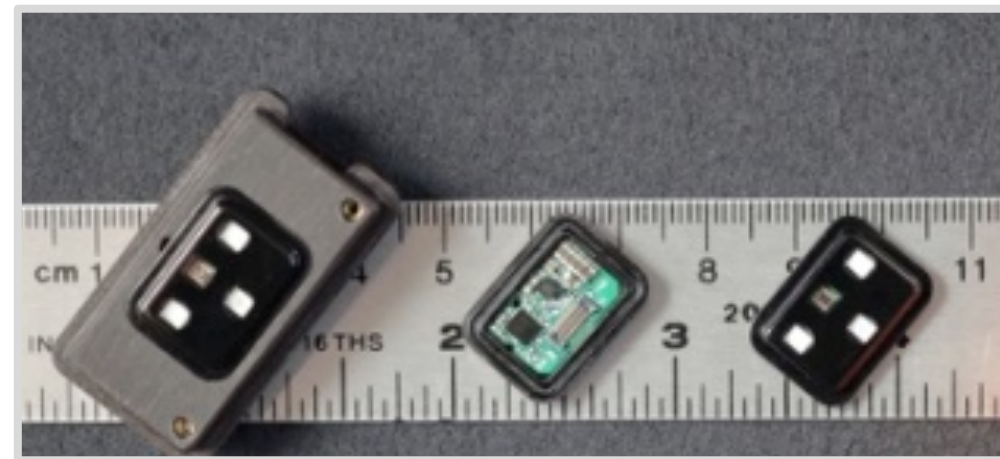
Hearing Aids



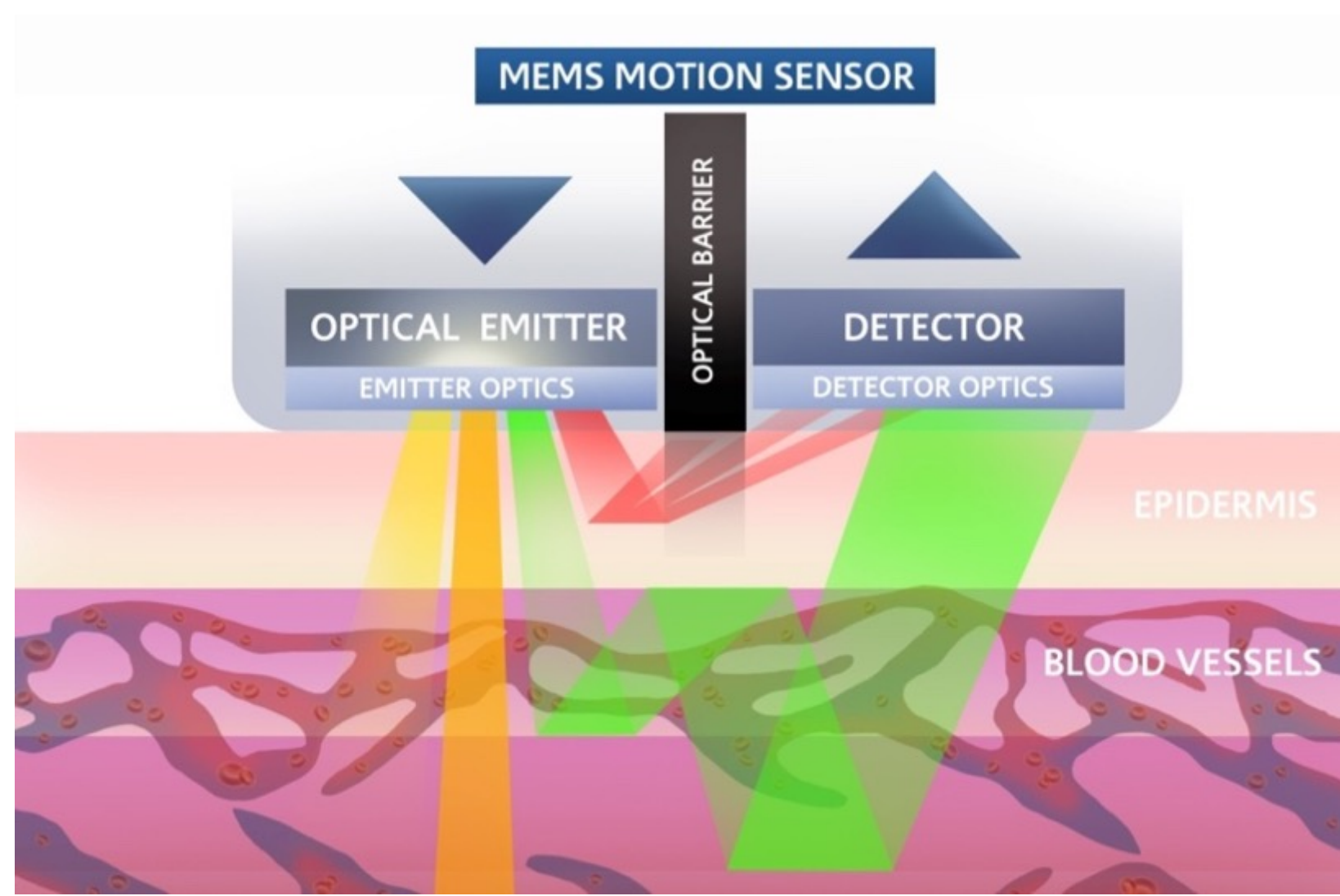
Smart Phones



Valencell Sensor Technology

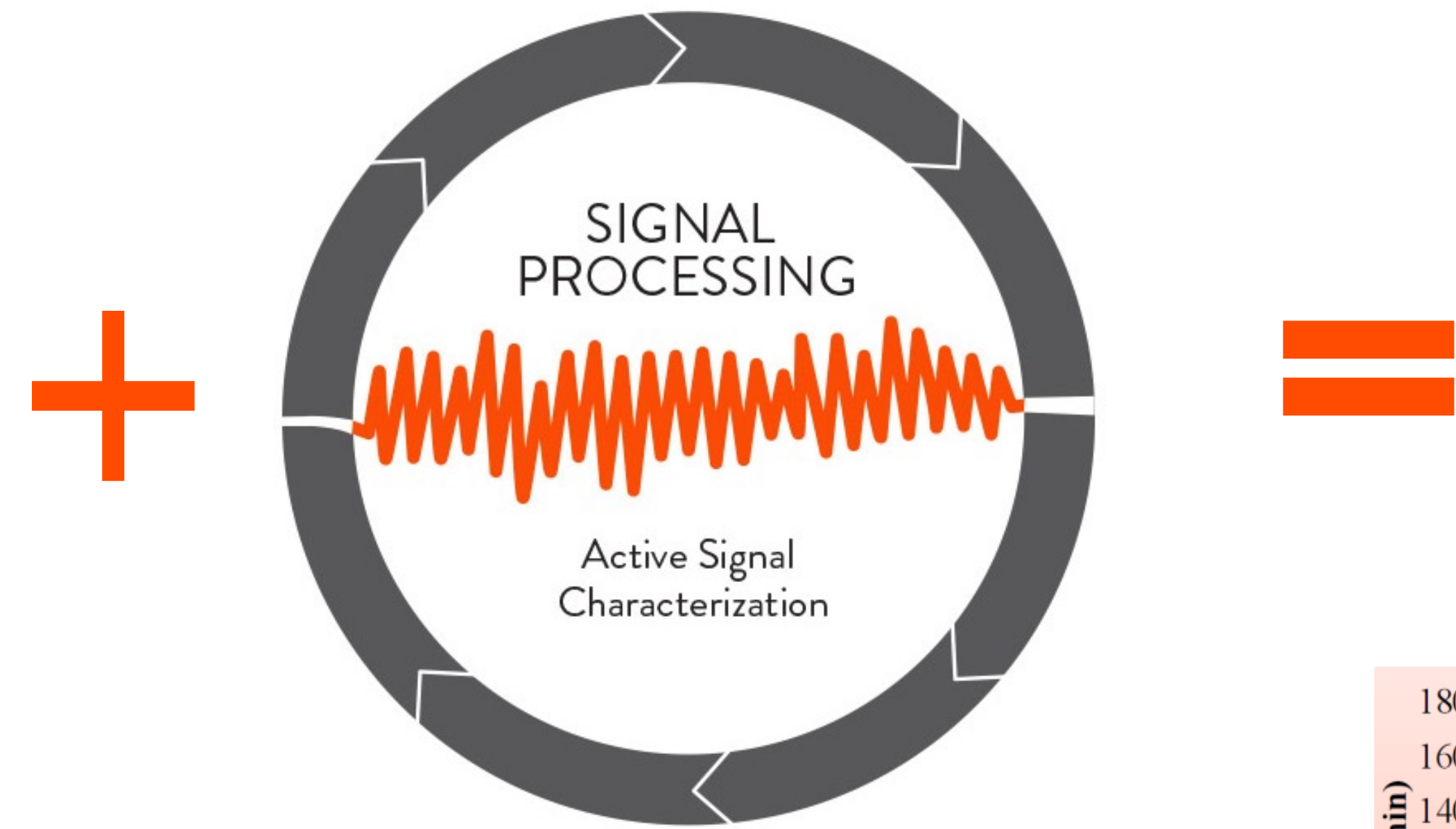


Valencell has pioneered breakthrough technology for biometric wearables



PPG Sensor Systems

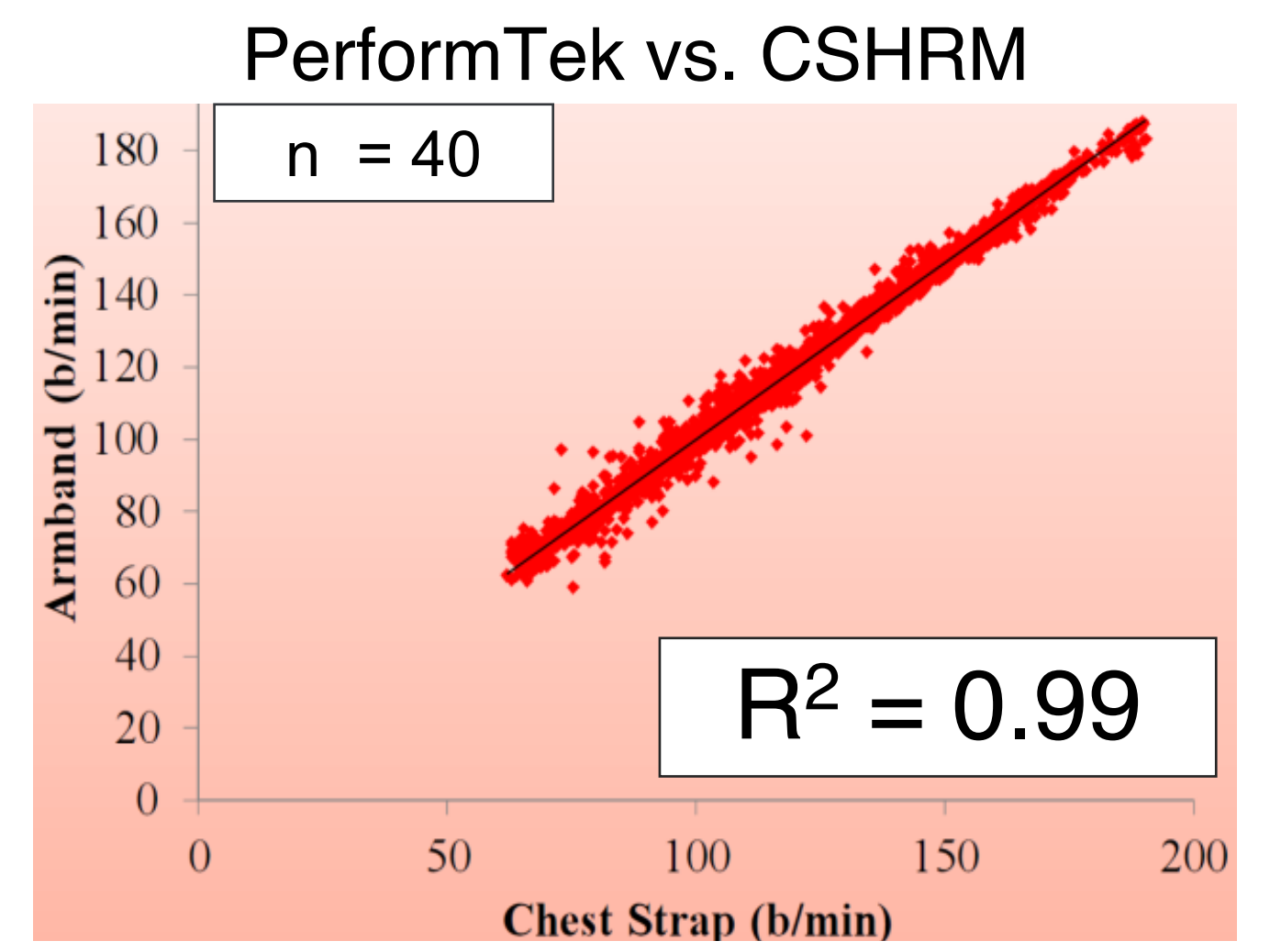
Years of R&D have resulted in advanced optomechanical designs and integration expertise that optimize sensor signal quality.



Active Signal Characterization

Optical noise from skin motion, body motion, & environmental noise (such as sunlight) is actively removed from the blood flow signals in real-time.

Highly Accurate PPG Signal



Strong external validation for Valencell technology

Technology validation from world renowned institutions



Duke
UNIVERSITY



White papers available at:
www.valencell.com/white-papers

Excellent product reviews and user experiences



Jabra GN

“We actually found that, watching the two figures side-by-side, the Jabra was **faster to respond to your heart than a Garmin chest strap**. As we climbed from 100bpm to 190bpm in our three minute sprints, the Jabra climbed much quicker, something **we've not really seen before from an optical sensor.**”

W A R E -- Wearable.com



SCOSCHE®

“...the Rhythm24 uses Valencell technology—the **gold standard** in optical pulse tracking.”

-- *Outside Magazine* 

Valencell Benchmark[®] Sensor System

Valencell Benchmark is a turn-key biometric sensor system in a ready-to-integrate module with all of Valencell's latest technology.

Benchmark includes:

- Sensors
 - LED emitter/detector sensor electronics
 - Optical lensing and patented optomechanical designs
 - 3-axis accelerometer to track activity
- Low power ARM[®] Cortex[®] processor
 - Advanced algorithms to remove noise during heavy activity and provide health & fitness assessments

Benefits:

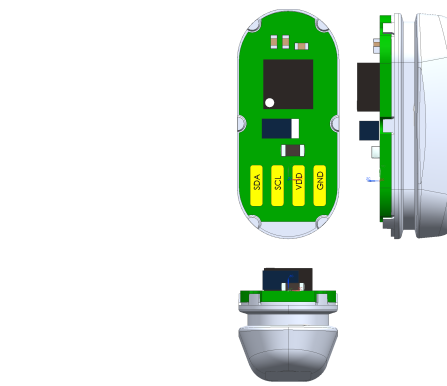
- Single, turn-key solution
- Proven, accurate biometric sensor technology in a ready-to-integrate package
- Experience & expertise in technology integration in many different form factors
- Robust roadmap of future innovations available via upgrades

Biometric sensor systems and reference designs for multiple body locations

Hearable

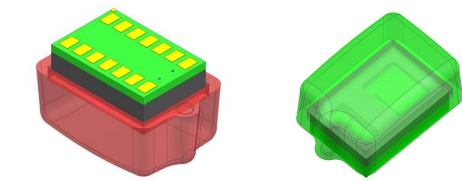
SONION

BE4.0



10.0 x 4.4 x 5.0

BE5.0



6.1 x 3.9 x 3.5

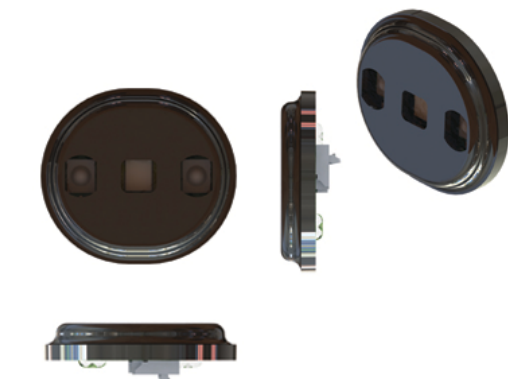
Wearable

BW1.5



19.5x14.5x3.25

BW4.0



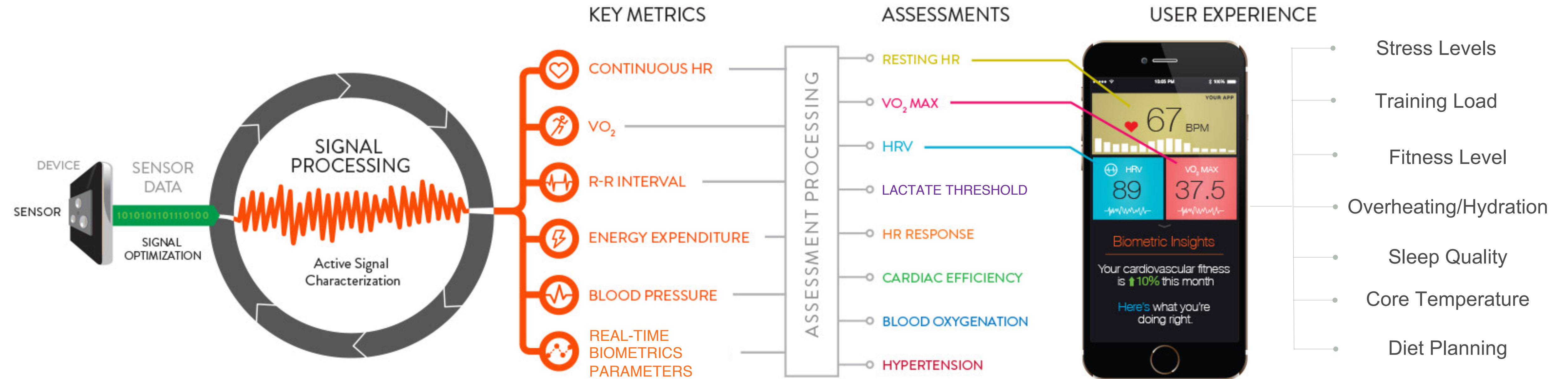
15.2x13.6x3.6

BE5.0 - Chest Strap Accuracy Without the Chest Strap

- BE5.0 is designed for hearables and provides chest strap accuracy without the chest strap; and is better from a comfort/usability perspective
- BP compatible
- MWL/SpO2 compatible

Tests	N	MAPE	StDev	Max	Min	DUT +/- 5%	Bad CSHRM	Notes
CSHRM Gel v No Gel	20	2.03%	5.24%	21.83%	0.07%	94.71%	0	<i>*left in CS failures</i>
Valencell BE5.0 v CSHRM Gel	20	1.07%	0.42%	2.55%	0.62%	98.02%	0	<i>*left in CS failures</i>
CSHRM Gel v No Gel	17	0.23%	0.18%	0.76%	0.07%	99.60%	3	<i>*removed bad CS</i>
Valencell BE5.0 v CSHRM No Gel	17	1.10%	0.47%	2.72%	0.64%	97.78%	3	<i>*removed bad CS</i>

The Valencell approach



Provided by Valencell

Supported by Valencell

Biometric Sensor Systems

Real-time metrics delivered to host processor

Example code for generating high-impact assessments

Biometrics test lab continually testing devices and UX's

DeepPPG data science capabilities

Valencell metrics available today

Real-Time Metrics (PerformTek Firmware)		Biometric Parameters (PerformTek Firmware)		Example Use Cases
Metric	Location	Metric	Location	
HR - Continuous & Motion Tolerant	Hearable / Wearable	Signal Quality	Hearable / Wearable	Knowing when and when not to use the data for assessments
Resting R-R Interval (RRI)	Hearable / Wearable	Off Skin Detection	Hearable / Wearable	
VO₂, Caloric Burn Rate, Total Calories	Hearable / Wearable	Normalized Pulsatile Amplitude	Hearable / Wearable	Indications of blood flow characteristics including pulse pressure, blood perfusion, and cardiac output
Cadence – Walking, Running, Cycling	Hearable / Wearable	Non-Pulsatile Amplitude	Hearable / Wearable	
Step Count, Total Steps, Pace, Distance	Hearable / Wearable	Ambient light average	Hearable / Wearable	Respiration characteristics
Blood Pressure	Hearable	Raw Accelerometer Data	Hearable / Wearable	
		Activity Identification – Rest, Walking, Running	Hearable / Wearable	Average daily sunlight exposure

Derived Assessments

Derived from HR in App

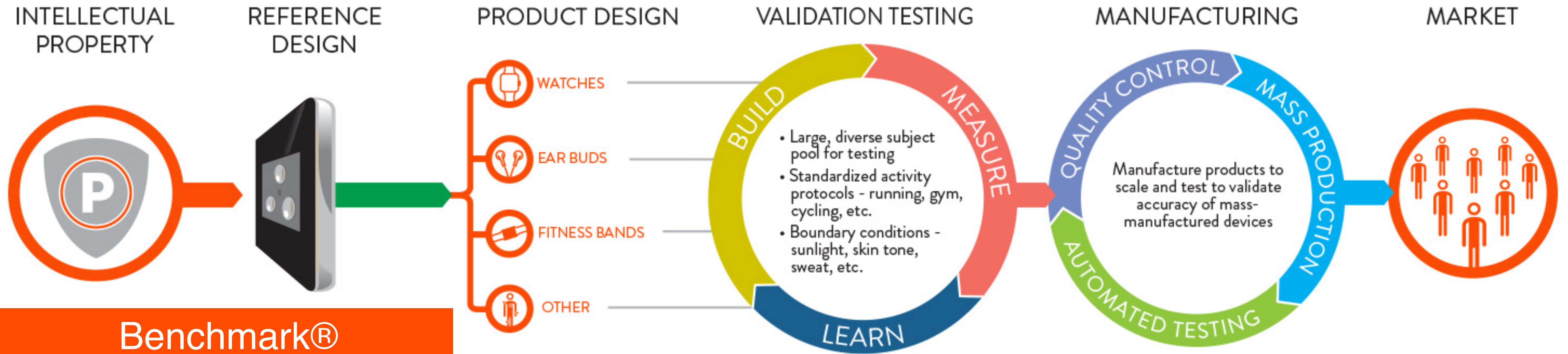
Derived from RRI in App

Derived from BP in App

Examples of Derived Assessments to enhance the user experience are shown below. Supporting evidence for each use case is given in App Note (Doc # 001432)

Assessments (App Note)		Assessments (In-development)		Assessments (Future Ideas)	
Metric	Location	Metric	Location	Metric	Location
HR Zone	Hearable / Wearable	Hypertension Indicator	Hearable / Finger	Hydration Status	Hearable / Wearable
Cardiac Efficiency	Hearable / Wearable			Cardiac Output	Hearable / Wearable
HR Recovery	Hearable / Wearable	Sleep Monitoring	Hearable / Wearable	Cardiorespiratory Status & Trending	Hearable / Wearable
Resting HR	Hearable / Wearable	HRV Biofeedback	Hearable / Wearable	Cardiovascular Screening & Trending	Hearable / Wearable
VO₂ Max	Hearable / Wearable	Pulsatile blood flow	Hearable / Wearable	Sleep Disorder Detection	Hearable / Wearable
HR Variability (HRV)	Hearable / Wearable			Vital Status Indicator	Hearable / Wearable
Weekly Training Effect	Hearable / Wearable	Glucose trending	Hearable / Wearable	Stroke Detection	Hearable
Core Temp Estimates During Exercise	Hearable / Wearable	Lactate Threshold	Hearable / Wearable	COPD	Hearable / Wearable
Attentiveness Monitoring	Hearable / Wearable	Cognitive Load	Hearable / Wearable	Exercise Guidance	Hearable / Wearable
Stress Analytics	Hearable / Wearable	Fall Assessment	Hearable / Wearable	Respirations Rate	Hearable / Wearable

It takes more than a sensor



Benchmark®

Provided by Valencell

Supported by Valencell

Biometric Sensors & Reference Designs – Ear & Arm/Wrist

Product design guidance

World-Class Biometrics Testing Lab and DeepPPG Data Science

Automated manufacturing tests

PerformTek Certification

Intellectual Property Portfolio

Optical, electrical, mechanical expertise

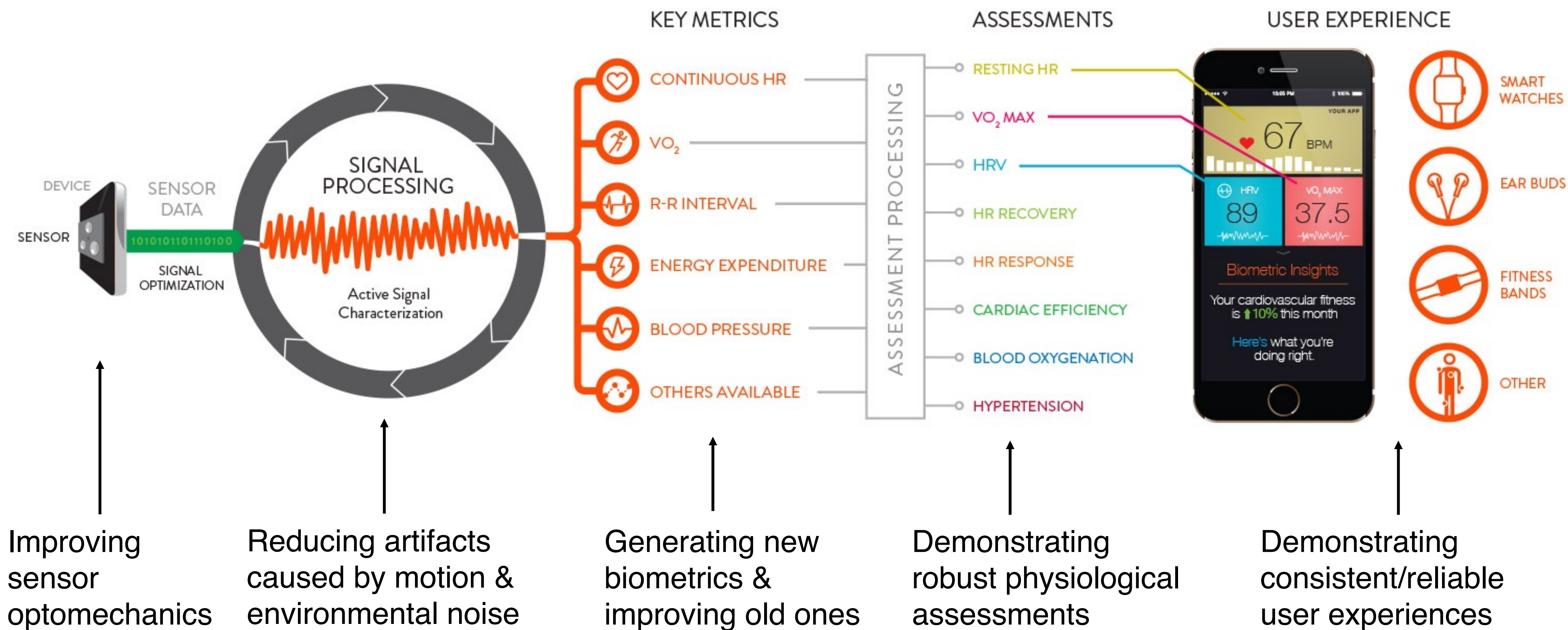
Independently validated technology

Certified manufacturers

Marketing Support

Data science for wearable biometrics

Valencell's approach applies data science to every aspect of the wearable solution



Device Testing

Extensive testing is critical to product development

The Valencell Biometrics Lab is a cutting edge biometric science lab that provides comprehensive wearables performance analysis for customers' product development.

- Team of exercise scientists and data scientists lead by PhD Exercise Physiologist Dr. Chris Eschbach
- Hundreds of volunteers testing prototypes and new technology monthly
- Validation datasets on participants of numerous body types, fitness levels, gender, & skin tones
- Testing protocols that match the use cases - resting, lifestyle activities, mild exercise, aggressive exercise, interval training, etc.
- Testing facilities for running, biking, swimming, gym activities, lifestyle activities, industrial safety, and more



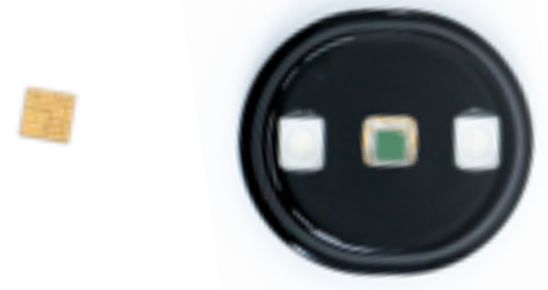
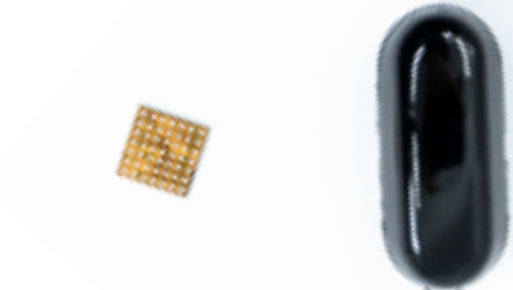
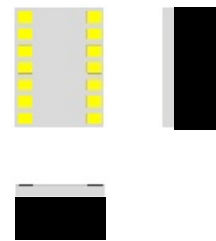












Biometrics Lab testing each year:

- Conducts over 24,000 different device tests
- Analyses over 12 million biometric data points
- Measures over 1,200 hours of testing & validation sessions

Developer Tools

Benchmark Evaluation Kits

	BW1.2/1.4	BW2.0/2.1	BW4.0	BE4.0	BE5.0
Sensor Module					
Wireless Demo System (includes sensor module in wristband or earbuds with BLE and battery)					
Development Board					

Valencell Evaluation Kits also include access to Benchmark product documentation, communication protocols, and integration guides

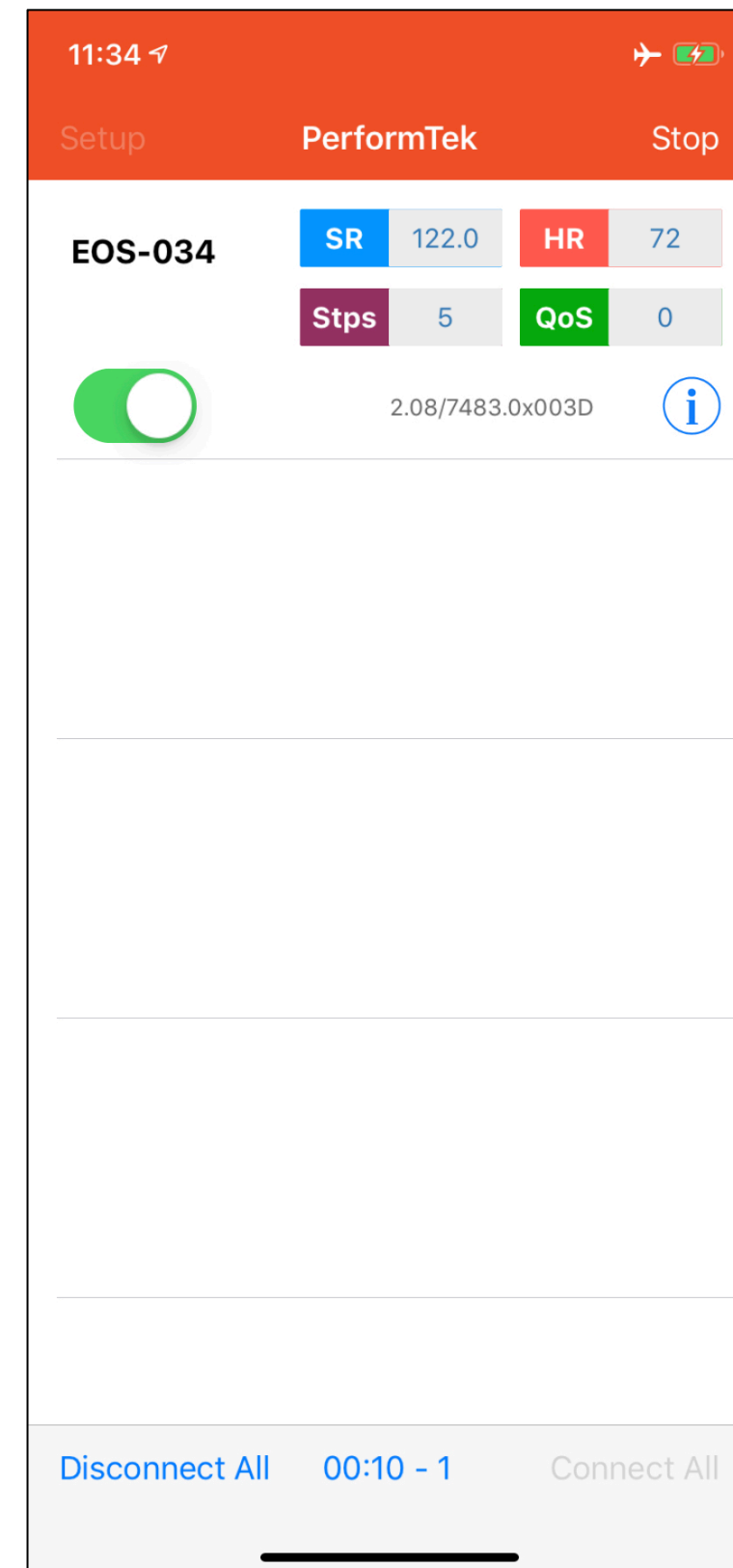
Software tools and examples

- **PerformTek app for PC's**
 - .exe available on Sharefile
- **USB Development Platform Example Code – Available**
 - Base interface code modified for use on PC platforms
 - Shows how to configure the Benchmark sensor and retrieve metrics
- **Embedded Example code**
 - Base code to start development on an embedded processor
 - Shows how to configure the Benchmark sensor and retrieve metrics
 - Wearable – Cypress BLE platform – Available
 - Hearable – Qualcomm CSR8670 – Available
- **Wear OS (and other wearable OS) Drivers**
 - Qualcomm Driver – Demand Driven
 - MediaTek Driver – Demand Driven

Mobile applications and support

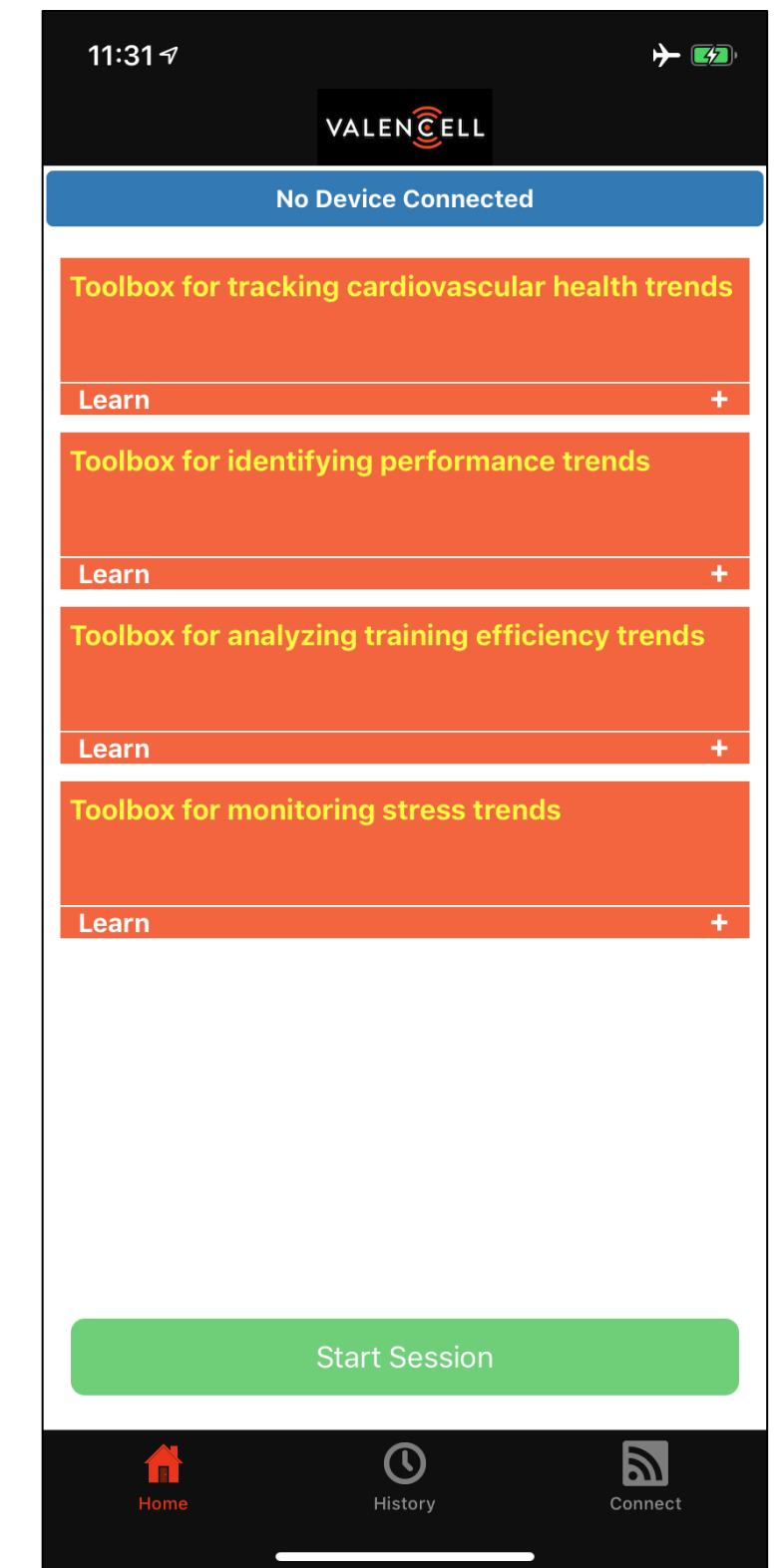
Mobile Data Collector App

- Collects data from multiple devices and it is great for testing BLE HR devices
- App for **iOS** based devices (available on the app store)
- App for **Android** based devices (available via Sharefile download)
- Source code available



Biometric Assessments App

- Same engine as the Mobile Data Collector but shows examples of assessments
- App for **iOS** based devices only (available via Test Fairy; pending app store review)
- **Source Code Available**
 - Requires signing a Software License Agreement (SLA)
 - Source code provides examples of assessments shown on the metrics roadmap



Why Valencell?



- Valencell transforms the science of wearable biometrics to enable impactful health outcomes.
- Through our innovative R&D and validated technologies, we develop breakthroughs and collaborate with wearables, hearables, and medical device companies around the world to deliver amazing results.
- Turn-key biometric sensor system for biometric wearables of all kinds – with robust product pipeline with next-gen biometrics, such as respiration rate, blood pressure, blood oxygen, & more
- We power more biometric products than any other company in the world
- Over 80 patents granted and 100+ pending that are the most cited patent portfolio in wearable PPG

We are your partner in creating advanced biometric wearables that have meaningful impact on your business and your customers lives.



Thank You!

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