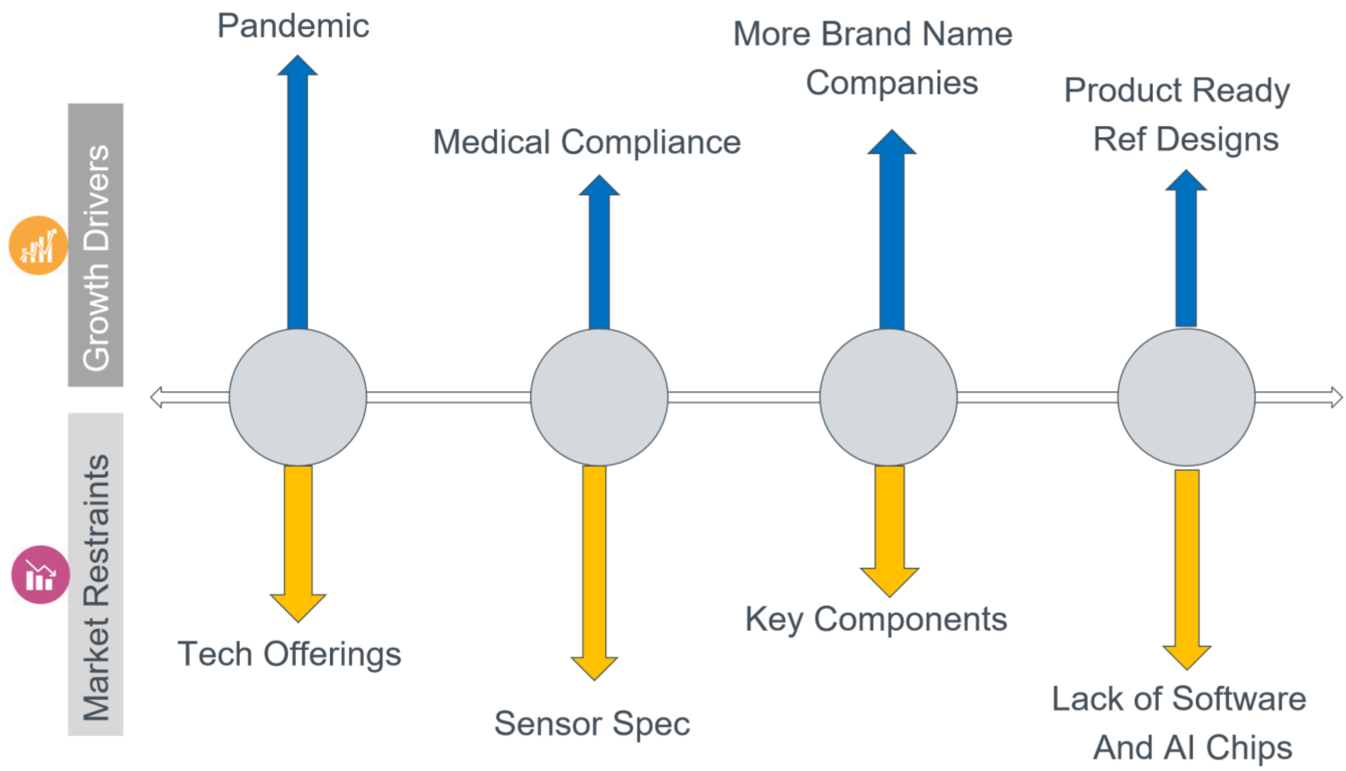
Growth of Medical Sensors & Electronic Components Demand Due To Covid-19

White paper

Introduction

It is no surprise that the novel coronavirus SARS-COVID-19 has had a massive impact on consumer, medical, and technology markets across the world. One of the results of this global pandemic, however, may lead to a positive trend in the development and use of patient monitoring, personal health monitoring, and at-home care systems. This result could be an increased focus in portable and on-body wearable medical devices leveraging the latest in miniature electronic components and sensors.

As governments, health insurance organizations, and individuals employ medical wearables to reveal early signs of illness, including illness that may lead patients to be more susceptible to other diseases, these trends are likely to continue. This whitepaper examines key considerations and developments for medical wearables and the different parts ROHM provides that are appearing in wearables at a time when accuracy and reliability is more critical than ever.

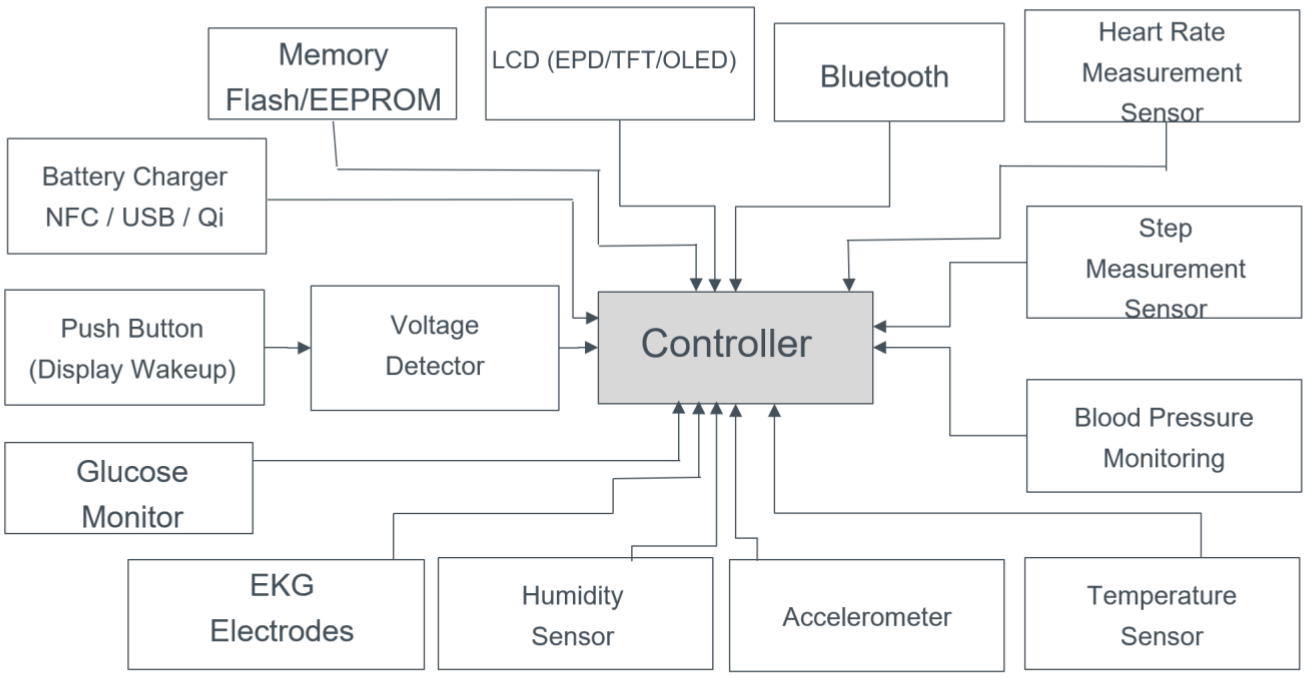


Key Market Growth Areas and Constraints

Hardware Considerations for The Latest Medical Wearables

In general, there has been a consistent trend for medical wearables to be more compact, more power-efficient (longer battery life), increasingly reliable, and available with more value-added features at lower costs. Some of these trends coincide with common semiconductor manufacturing trends for smaller and higher performance components and devices, and some are specific to medical applications, as in the case of medical sensors specific to medical wearable applications.

Moreover, there are also growing trends to incorporate smartphone connectivity with medical wearables, or some type of display and control interface that enables a greater range of user and medical professional customization. Hence, connectivity and interfacing with medical wearables is an area driving hardware considerations such as communication, touch screens, displays, interfacing, and smartphone apps.



A common medical wearable is now composed of a variety of sensors, signal conditioners, signal processors, data processors/controllers, memory/storage, and passive components and devices.

Hardware Types and Specific Considerations

Part of the growing trend of employing medical wearables for early detection of illness and disease data tracking is the use of several sensors to yield valuable data through sensor fusion or to enable new sensor features. An example of this is the use of an accelerometer and/or GPS to aid fitness tracker algorithms in determining what type of activity in which a user is engaging. Other considerations, especially if there is a need for medical compliance, rely on the performance and grade of hardware. In some cases, this requires design, performance, and manufacturing practices to coincide with standards, and in other cases, it requires an entire design to be certified.

[Multi-axis Accelerometers]

Medical wearables increasingly benefit from sensor fusion and outright use of multi-axis accelerometers. The key considerations for these devices are the use of embedded signal conditioning circuits for enhanced accuracy as well as advanced battery-saving features. The resolution of the accelerometer output is also a key for medical wearables as increased processing power is available for algorithms to better analyze on-body wearable data. Built-in features that reduce error from process variation, environmental factors, and temperature are also important to maintain the quality of data from the accelerometers over the lifetime of the medical wearable. This also includes the use of internal regulators to ensure consistent operating regardless of fluctuations in power supply voltage. Lastly, integrated algorithms that can detect direction, free fall, and activity are extremely valuable as they shift processing requirements from the central medical wearable processor to the device. This allows for the greater utility of the medical wearable without having to have an upgraded processor to handle greater processing load, or in some cases, even power up the processor as the calculations are handled on the accelerometer device itself.

[Pressure Sensors]

Pressure sensors are used in a variety of medical wearables, including medical health monitors, ventilators, smartwatches, dive computers, smartphones, sleep monitors, fitness bands, and many others. Key considerations for pressure sensors are accuracy and reliability. Other key considerations are pressure sensors that can withstand exposure to water and retain accuracy at depths. For these applications and other medical wearable use cases, pressure sensor form factor is often a limiting factor and has increasingly become a dominant specification.

Especially in medical wearable and medical device applications, the pressures in living systems tend to be low compared to mechanical systems. Hence, low-pressure accuracy is essential for these applications, and greater accuracy and resolution at low pressures can provide much more valuable data. For pressure sensors, temperature compensation and correction is necessary to yield accurate measurements, especially when used as altitude monitors in wearables and activity monitors.

[Operational Amplifiers]

Operational Amplifiers (OpAmps) are very common signal conditioning devices necessary in amplifying very low voltage/current signals to the levels necessary for signal processing circuits to operate. OpAmps are also used extensively in analog control circuitry, which makes their performance-critical in medical sensors and medical wearable applications. As the quality of the analog signals passing through OpAmps is directly impacted by the performance of an OpAmp, it is crucial that OpAmps for medical wearables exhibit minimal signal degrading factors and can rapidly respond to the changes in signals for dynamic living systems. Moreover, OpAmp efficiency is also a key consideration for body-worn applications that may rely on batteries for weeks or months at a time.

[Ultra-Compact LEDs]

Light-emitting diodes (LEDs) are very important for users, device designers, and medical professionals that use medical wearables and health monitors. In many cases, the use of a complex display or wireless communications is too slow, too high powered, or too cumbersome for medical professionals or users to rely on for certain types of medical wearable applications. In these cases, LEDs used to indicate status, connectivity, function, and when errors occur are extremely helpful and can avoid undesirable operation modes.

It is important that LEDs in medical wearables and health monitors to have an extremely small footprint (width, length, and height), have a wide operating temperature range, a desirable light pattern, be extremely efficient, provide a good luminosity to size ratio, and to come in a variety of colors or have multiple color output capability.

[Resistors]

Resistors are ubiquitous to electronic circuits and can be found in an expansive variety of shapes in sizes. In the case of medical wearables and health monitors, it is often the case that smaller is better. Other important factors about resistors are also the accuracy of the resistor value, the surface mount technology (SMT) part profile, and if the part is rugged enough to withstand environmental extremes without degrading its accuracy. Among these, accuracy over temperature is critical, as medical wearables can either be located near the body with limited thermal management or on a person's extremity, such as a wrist, on a cold mountaintop.

[EEPROMS/FeRAM]

The choice of volatile and nonvolatile memory for medical wearables is as critical as the choice of sensor and communication technology. As device memory is used to store important sensor data and accessed during processing and communication, quality memory that responds rapidly to read commands is increasingly important. Another consideration is that the higher resolution data from medical sensors can be very valuable in more accurately determining signs of illness or condition. Higher-resolution data requires greater volumes of memory. This is why the density of EEPROMs and FeRAM is also of growing importance as the small form factors of modern medical wearables have little room for additional memory chips.

Optical Heart Rate Monitors for Heart Rate, Blood Pressure Measurements

Optical heart rate monitors measure heart rate (pulse waves) using semiconductor-based optical sensing technology, which typically involves transmitting light from an LED and detecting the reflected light off the target object using a light-receiving block such as a photodiode or phototransistor. Since hemoglobin that exists in arterial blood has absorption characteristics, it will be possible to detect changes in hemoglobin amount and determine the heart rate by sensing the amount of light over time.

In recent years, after taking into account load and mountability on the skin, reflector-type sensors using green light have become mainstream in smart bands and watches equipped with

optical heart rate monitors. Green light features a small penetration depth that affects only blood, not tissue. This, combined with the large absorption coefficient of hemoglobin, enables easy measurement of heart rate signals with a large pulsation component.
Since the Pulse Waves captured can be of high resolution, it is easy to extend the use of the same Optical Heart Rate Monitor to use it to compute the Blood Pressure as well. There are PPG (PhotoPlethysmoGraphic) Algorithms that help calculate the Blood Pressure from the Pulse Waves.

[Bluetooth 5.0]

Wireless communication and integration with smartphones and apps is of growing volume in medical wearables for both personal monitoring and professional medical analysis. As many medical wearables are battery operated and extremely compact, Bluetooth connectivity enables a very compact wireless solution that is also very power efficient and secure. Most modern smartphones have Bluetooth capability, which enables very wide use and easier training/analysis from both users and medical professionals. Moreover, the use of Bluetooth connectivity allows for data to be transferred from a device to a smartphone, which typically has much greater memory storage ability and WiFi/Cellular connectivity which can then transfer data to cloud services or secure medical servers. In this way, Bluetooth connectivity can result in smaller, more efficient, and more capable medical wearables whose features can be enhanced by the use of apps and external analysis and reporting technology. As Bluetooth 5.0 is the latest generation of Bluetooth, it is superior to prior generations in terms of communication protocol, power efficiency, compatibility, and device integration features.

[NFC Charging Circuitry]

Wireless charging has had its ups and downs in the general consumer marketplace but has become indispensable for many medical wearable applications as the size and form factor for NFC charging technology has continued to shrink. With more compact NRF charging solutions, even very small medical wearables can be reliably charged without the need for hard to use and failure-prone physical connectors that tend to add bulk and cost. NFC charging also enables a completely sealed medical wearable, which is less prone to environmental ingress and associated failure modes. Given the very small size goals of hearables, augmented reality/virtual reality (AR/VR) headsets, and smartwatches, extremely small NFC charging solutions are a key enabler of future medical wearables.

[ROHM Devices and Parts Found in Medical Wearables]

The following table lists the ROHM parts that can be found in various medical wearables:

ROHM Devices	Applications	ROHM Parts			
Accelerometer	BP, SpO2, CGM, Fitness, In ear-hearables, Headphones	KX132-1211	KX134-1211	KXTJ3-1057	
Phototransistors	SpO2	SCM-014TB	SML-810TB	SML-H10TB	
Proximity Sensor	Hearing Aids, Fitness, Headphones, BP, SpO2	RPR-0521RS	RPR-0701		
HRM	BP, Hearing Aids, In-Ear-hearables, Fitness, SpO2, Headphones	BH1790	BH1792		
Photo Diode	SpO2, Headphones, Smart Watch, HRM	RPMD-0100			
IR LED	Hearing Aids, Headphones	SCM-013RT	SIM-040ST	SIM-030ST	SMLM13RT
Hall Sensor	AR/VR headsets	BU52792	BU52494	BU52098	
ALS	Headphones, Fitness	BH1721FVC	BH1726	BH1730	BH1620
Direction Detector	Caregiver Applications	RPI-1035			
Pressure Sensor	Fitness	BM1386GLV	BM1383A		
Color Sensor	Camera Applications	BH1749NUC	BU27006		
Operational Amplifiers	All Applications	BU7242NUX			
Pico LEDs	BP, Hearing Aids, In-Ear-hearables, Fitness, SpO2, Headphones	SML Series			
EEPROMS	All Applications				
FeRAM	All Applications				
Magnetometer	Hearing Aids, Headphones, in-ear-hearables	BM1422A			
NFC Charger	Hearables, AR/VR headsets	LM7630/31			
Bluetooth 5.0	Multiple Applications	MK71511/21			

Conclusion

As pandemics, such as COVID-19, and other common diseases continue to take a toll on society, enterprising medical wearable and health monitor innovators are developing wearables that can help provide valuable monitoring and reporting features. In order for this new generation of medical wearables to succeed in a highly competitive market with stringent performance requirements, it is essential for the device and components within these wearables to exceed the competition in form factor, cost, efficiency, and performance. ROHM Semiconductors offers a host of devices that provide critical data to users in their medical devices.

Resources

1. Medical tech trends accelerated by COVID-19
2. Global Medical Wearables Market 2020 COVID-19 Impact, Share, Trend, Segmentation and Forecast to 2027
3. https://www.allaboutcircuits.com/news/manufacturers-making-their-own-wearables/
4. https://www.rohm.com/news-detail?news-title=roki-sensor-node&defaultGroupId=false
5. https://www.rohm.com/pulse-wave-sensor
6. https://www.medgadget.com/2020/07/medical-sensors-market-to-expand-at-9-0-cagr-by-2025-covid-

19-impact-analysis-industry-size-estimation-share-technokogy-trends-growth-swot-analysis-top-company-profile-merger-regional-statisti.html
7. https://www.globenewswire.com/news-release/2020/06/23/2051729/0/en/World-Market-for-Medical-Sensors-to-2027-and-the-Impact-of-Covid-19.html
8. https://www.marketwatch.com/press-release/global-medical-pressure-sensors-market-covid-19-impact-on-industry-size-share-2020-movements-by-trend-analysis-growth-status-revenue-expectation-to-2026-research-report-by-research-reports-world-2020-07-07

ROHM Co., Ltd.
2323 Owen Street,
Santa Clara, CA 95054 U.S.A
TEL : +1-408-720-1900
www.rohm.com