Silicon Labs Sensor Market, Application, Solution Overview

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Silicon Labs offers a variety of sensor products that are used in traditional applications like thermostats, wireless handsets and automotive as well as emerging applications like wearables and IoT.
More and more applications are making use of sensors every day. Silicon Labs is seeing tremendous growth in all of these applications, including Internet of Things, Wearables, Healthcare, Automotive, Proximity Detection and Environmental Monitoring.
Sensors for IoT

- Market
  - Industrial
  - Home Automation
  - Health
- Simplicity and full solution
  - Thunderboard Sense Demo
  - PIR occupancy sensor solution
  - Door/window sensor solution
  - HRM solution: wireless, algorithm, sensor
  - Optical module
- End to End connection
  - Sensor with MCU or Wireless SoC

Thunderboard Sense Demo

**IoT wireless sensor nodes**
**Visualize the sensor data**
**Open source basic cloud and analytics demo**

**Silicon Labs Sensors on Thunderboard Sense**
- Magnetism Si7210
- UV index, ambient light: Si1133
- RHT: Si7021
Silicon Labs offers a variety of sensor products that are used in traditional applications like thermostats, wireless handsets and automotive as well as emerging applications like wearables and IoT.
Rare earth magnet can be expensive, a more sensitive sensor will reduce the size of the magnet and save cost. The power can be as low as 400nA at 5Hz, enough to replace reed switch, which is bulky and less robust. DFN package is suited for height sensitive application. Built in self test is a desired feature for automotive industry.
We are launching 3 families of parts. The Si720x switch and latch parts have a digital indication of magnet presence, the Si7210 parts add the capability of setting on/off thresholds and reading the value of the magnetic field. The Si721x parts have a linear output in analog, PWM or SENT format.
Here's some of the advantages Si72xx provides for Switch/Latch Applications

The 400 nA (at 5 Hz sampling rate) and High sensitivity let you use it in battery powered applications without impacting the battery life, and to reduce the size/cost of the magnetic component, and makes it an ideal replacement for reed switches.

The tamper detect feature acts as a second threshold that goes off when it detects a magnetic field that is too high - for example, thieves trying to use a strong magnet to keep the sensor un-tripped when the door is closed.

The built in temp sensor (1.0C accurate) allows you to save area and cost on a BOM component.

The AEC-Q100 grade reliability allow you to use it in automotive applications.

Silicon Labs has multiple 3 and 5 pin parts, which are available in the industry standard SOT-23 package. Many of them are pin compatible with popular parts on the market today, which allows you to keep your existing design, and take advantage of improved performance and power.
The two sensors will receive magnetic field with a phase difference. The angular position can be determined by the 2 values of the B field definitively.
Hall effect magnetic sensor cases studies

- Coffee maker uses disposable pods
  - Design constraints
    - Need to differentiate different size pods
    - previous magnetic sensor, Not enough sensitivity for all cases
- We win because
  - High sensitivity
- Similar Cases
  - Soap dispenser
- Disposable Syringe
  - Design constraints
    - Space limited
  - Long shelf life
- We win because
  - Low power
  - Thin package 0.33mm
Silicon Labs offers a variety of sensor products that are used in traditional applications like thermostats, wireless handsets and automotive as well as emerging applications like wearables and IoT.
ALS stands for Ambient Light Sensor
Any device today preferably wake up upon detecting a person, this is the most common application of proximity sensor

### Optical Sensor – Target Markets

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![Proximity/ALS/Gesture Recognition images](image1)

![UV Sensing images](image2)
### Si1153 Module

Optical mechanical design can be challenging for customers, most of them do not have optical experience. The module will encapsulate the optical isolation, view angle and lens design, simplify the customer’s work. The module simplifies manufacturing process as well.

**Low Power consumption**

The shorter a pulse is, the lower the LED duty cycle will be. LED current can be the majority of power consumption.

**Long range detection**

Quite some application require a long range detection, our sensitivity allows up to 50cm detection without a lens.

**3 LEDs to support 2D gesture**

2 LEDs are required to detect X direction gesture, adding another LED can detect Y direction gesture.

**Sunlight Immunity**

Sunlight energy dips at 940nm, it is the water absorption line. An narrow 940nm bandpass takes advantage the characteristics of sun spectrum, reduce the level of ambient light seen by the sensor, allow the LED to be driven at a high current level without saturation, increase the range of detection under

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#### Proximity/ALS Sensors

- **Si1153 in QFN or Module**
  - 2 x 2 QFN for compact design
  - Module to reduce optical design complexity
- **Low-power consumption**
  - Pulse as short as 25.6 μs
  - 9μA at sampling every 800ms
- **Long Range Detection**
  - 50cm without lens, 2 meter with lens
- **3 LED drivers to support 2D gesture**
- **Sunlight immunity**
  - Unique 940 nm pass filter available
- **2 sensors in one package**

![Si1153 in QFN](image)
sunlight

2 sensor in one package

The proximity is the more popular application, the ALS sensor provides additional feature to allow backlight brightness adjustment, customer will buy one get one free.
The CAD file of the lens design is available at request
The manufacturer partner information for the lens is in the App Note AN950
UV Sensing

- Overexposure to UV increases risk of skin cancer
- Integrate UV sensors in wearables
- Low-power is a requirement

**SI1133**
- Output corresponds to actual UV index scale
- Accuracy ±0.75 UV scale unit with diffuser
- Low power consumption: <500nA standby current
- Includes ALS for backlight control & sleep tracking

**Why we win**
- The only digital UV sensor in the market
- Low Power
- Compact design
- Low cost
Optical Sensor – Case Study

- Background
  - Thermostats used by major OEMs
  - First Ecobee labeled product

Interesting Details
- Opportunity developed as a result of the MCU portfolio
- Display needs to be off until someone approaches

Why we win
- Low power
- Synergy with MCU and RHT sensor
Silicon Labs offers a variety of sensor products that are used in traditional applications like thermostats, automotive as well as IoT.
The Si70xx family is ideal for a variety of applications, including HVAC, Home Automation and Consumer Devices, Remote Monitoring, Asset Tracking, Automotive and Industrial Equipment, and Healthcare.

In HVAC, home automation and consumer devices, remote monitoring and asset tracking applications, the benefits of Si70xx include:
- Small size and minimal BOM reduces PCB area and overall cost
- Protective cover option prevents damage from cleaning agents like Windex and Ammonia
- Low power consumption extends operating life in battery-powered applications

In automotive, industrial and healthcare applications, the benefits of Si70xx include:
- High accuracy and reliability for demanding applications and long-term operation
- Protective cover option prevents contamination from dust, dirt and liquids
- Low power consumption extends operating life in battery-powered applications
The Si7006/13/20/21 and 34 devices feature an I2C interface for easy connection to MCU-based applications. Three different accuracy levels are available to choose from. The new Si7034 is available in a tiny 2x2mm package and is designed for applications like wearables and handsets where PCB area is a premium. The Si7013, 20 and 21 are targeted toward applications such as thermostats, automotive and medical devices that need higher accuracy and have a 3.3V power supply. For consumer applications like weather stations and printers, the Si7006 is a cost-effective alternative to discrete RH sensors, also with a 3.3V power supply.

All Si70xx devices support an extended -40 to +125°C temperature range. The Si7013, 20, 21 and 34 devices are AEC-Q100 qualified and offer PPAP support.

The optional cover/filter is available for all Si70xx devices except for Si7034.

The Si7020, Si7021 and Si7034 offers drop-in compatibility for customers using products from Sensirion or Measurement Specialties.
Relative Humidity & Temperature Sensor – Case Study

- Si7034 Great for consumer devices
- Why we win
  - Smaller form factor
  - 1.8V supply voltage
  - Lesser requirement on accuracy
Temperature is the most common environmental measurement and has a wide variety of applications across all customer segments.

Silicon Labs’ Si705x temperature sensor family offers industry-leading low power consumption, along with very high accuracy and precision.

Silicon Labs’ Si705x temperature sensors can be used in a variety of applications:
- Industry-leading low power consumption extends battery life
- High accuracy meets the needs of demanding applications
- 14-bit ADC delivers higher precision than MCU-based temperature sensors
Silicon Labs’ Si705x temperature sensors feature 4 accuracy levels and operate from -40 to +125°C temperature range and 1.9 to 3.6V Vdd range. The I2C interface connects easily to MCU-based applications while the 14-bit ADC provides high resolution measurements. For automotive applications, all Si705x devices are AEC-Q100 qualified.

Unlike competing digital temperature sensors, the Si705x devices maintain their accuracy level across the entire operating temperature and voltage range. For battery-powered applications, the industry-leading low 0.2μA current consumption is ideal.

Si7060 to be added when launched
Si7051 Case Study

- Application: Food safety
  - Si7051 will be used to monitor fridges and freezers in hotels, restaurants, supermarkets, food processing plants etc.
  - In Europe the (HACCP) regulation requires sensors must be within +/-0.5°C
  - Re-calibrated once a year

- Why we win
  - Excellent specifications. (+/- 0.1-0.25°C accuracy)
  - Good long term stability at <= 0.01 degC/year
Silicon Labs offers a variety of sensor products that are used in traditional applications like thermostats, wireless handsets and automotive as well as emerging applications like wearables and IoT.
• OHR market is segmented into Earbud, Performance Wrist, and Lifestyle wrist.

  • Earbuds are the smallest at IHS projected 4% in 2019 and provide chest strap performance today due to physiology of ear.
    • Valencell + Si114x solution for earbuds has no competitors yet due to IP/Patent position.
  
  • Performance segments needs better performance and is willing to pay for it. Most fitness band OEMs are in this category with 46% of the 2019 market
  
  • Lifestyle segments is most of the smart watch vendors with the exception of Apple. They want much better performance but consider costs as top priority.
Both module and QFN are offered. Module will encapsulate the difficulty of optical design, make the manufacturing process easy. QFN package will offer more flexibility for LED selection and placement. It can be used for customers need more performance.

At the high end there are Si117x (Module) and Si118x (QFN)
For cost sensitive customer, Si114X will provide the basic function at affordable price.

The 100uA total subsystem power will enable 24/7 continuous HRM monitoring
Silicon Labs provide library for ARM based MCU. For Silicon Labs Wireless SoC, complete sample project is available. The
Customers did a lot of additional performance testing
Si1172/82 ECG/PPG Sensors Summary

- Single chip optimized for wrist-based PPG/ECG
- Synchronized PPG and ECG measurements
- Built-in leads on/off detection
- Optimized for high impedance dry electrode
- Low sleep current: 500 nA
- 24 bit ADC with over 100 dB dynamic range
- 3.7x7.0x1.1 mm2 LGA module or 3x3 QFN
- Filter Remove muscle movement, drift, 50/60Hz hum
- HRM, HRV, RR interval algorithm
- Test report for Chinese FDA
Thankyou