Tech Talks LIVE Schedule – Presentation will begin shortly

Silicon Labs LIVE:

Wireless Connectivity Tech Talks
Summer Series

Topic	Date
Building a Proper Mesh Test Environment: How This Was Solved in Boston	Thursday, July 2
Come to your Senses with our Magnetic Sensor	**Thursday, July 9**
Exploring features of the BLE Security Manager	Thursday, July 23
New Bluetooth Mesh Light & Sensor Models	Thursday, July 30
Simplicity Studio v5 Introduction	Thursday, August 6
Long Range Connectivity using Proprietary RF Solution	Thursday, August 13
Wake Bluetooth from Deep Sleep using an RF Signal	Thursday, August 20

Please take the poll while waiting and be entered to receive a Thunderboard

Find Past Recorded Sessions at:
https://www.silabs.com/support/training

WELCOME

Silicon Labs LIVE:

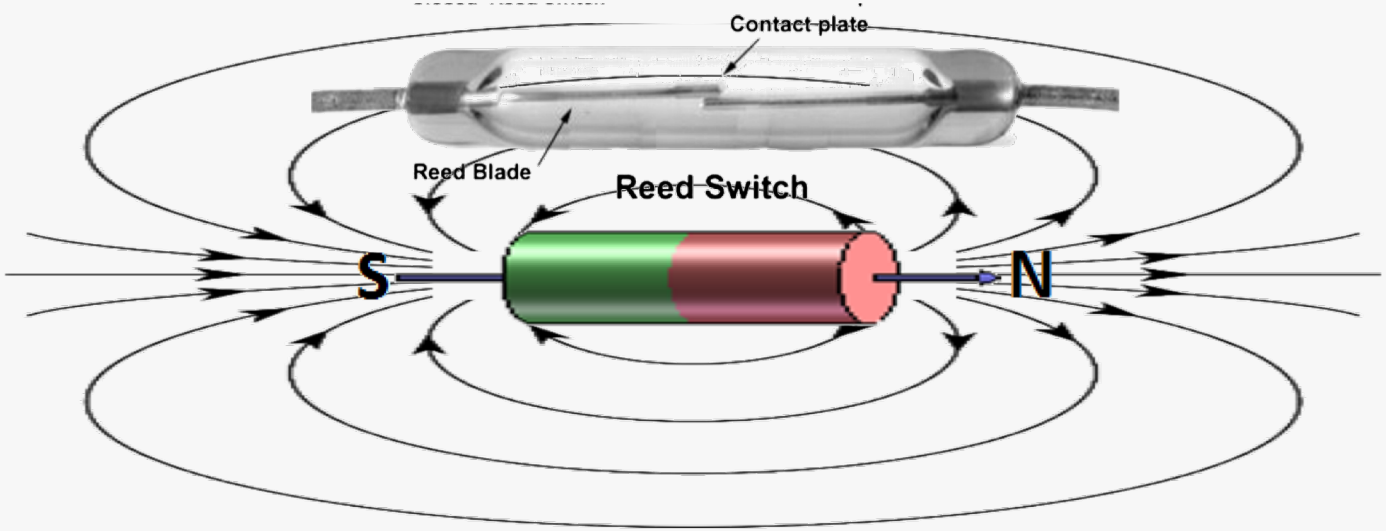
Wireless Connectivity Tech Talks Summer Series

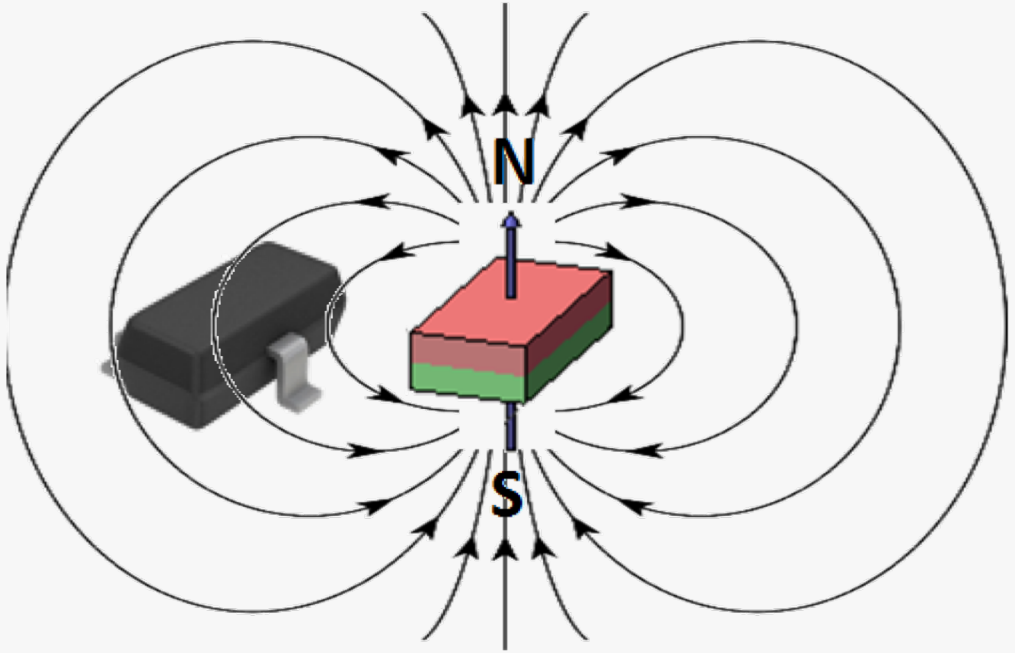
Come to your senses with our Magnetic Sensors

SI72XX HALL-EFFECT SENSORS

Reed Switch vs. Magnetic Hall-Effect Sensor

- Reed switches are simple devices, sensitive to parallel fields
- Hall sensors are sensitive to perpendicular fields

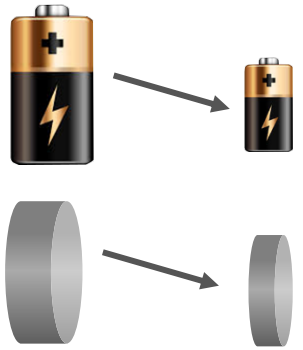


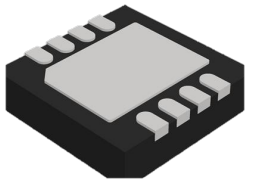


Reed Switches are “Dumb” sensors

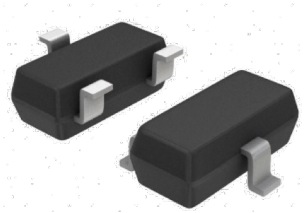
Features of Silicon Labs Magnetic Sensors

- Low Power – 400nA for 5 Hz sample rate
- High Sensitivity
  - 1.1mT (11 Gauss) B_{op}(magnetic field detection threshold) at 400 nA
  - <30 uT RMS noise
- Configurable over I2C
- Multiple output options
  - Analog, push-pull IO, open-drain IO, I2C, SENT, PWM
- Advanced features
  - Dual Threshold/Tamper Detect
  - Built-in Self Test capabilities
  - Ceramic Magnet Temperature Compensation
- Built-in Temp Sensor
- Available in industry standard packages and pinouts
  - SOT-23 , TO-92, DFN8

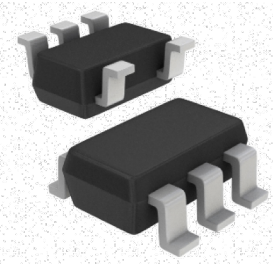




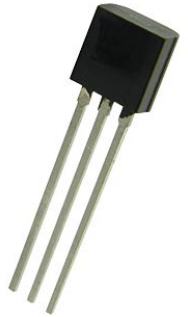
DFN8



SOT23-3



SOT23-5



TO92

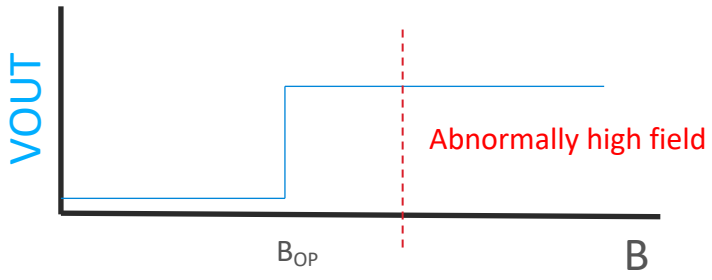
Feature Benefits

- No tradeoff between reliability and power
  - Reed switches have low power, but are unreliable
  - Typical Hall sensors have high reliability, but much higher power
  - With Si72xx, get superior reliability at ultra-low power
- Reducing product sizes and cost
  - Reducing magnet size due to superior sensitivity
  - Reducing magnet cost with built in ceramic compensation
- Ultimate flexibility in development and deployment
  - I2C configurability lets you tweak design without replacing parts
  - I2C configurability allows deployment calibration for non ideal installation
- No need to digitize analog outputs with digital readout
  - Saves power, hassle, inaccuracy

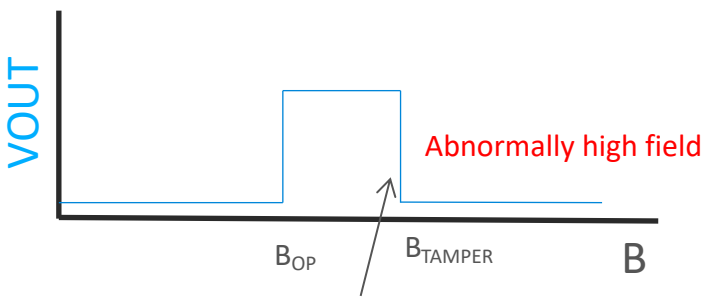
Tamper Detection

- Many security systems can be defeated with a strong external magnetic field
- The Si72xx can sense abnormally high fields and report them (select devices)
  - In 3 pin parts, the output reverts to the “0” field state
  - In 5 pin parts, the tamper event is reported over a different pin
- The tamper feature can also be used as a second threshold
  - Si720x have factory programmed tamper thresholds
  - Si7210 tamper thresholds can be configured over I^2C

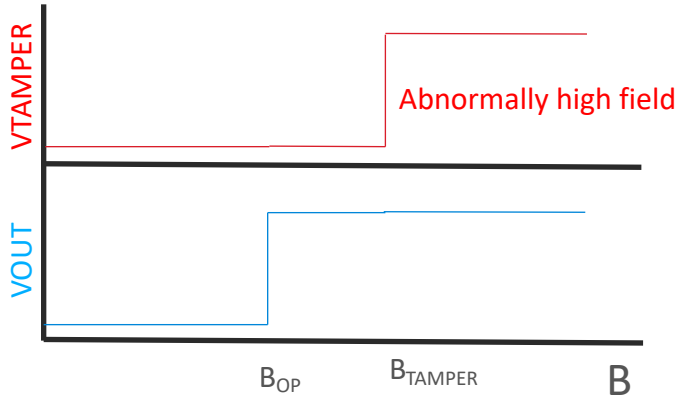
Standard Magnetic Sensor



3 pin Magnetic Sensor w/Tamper

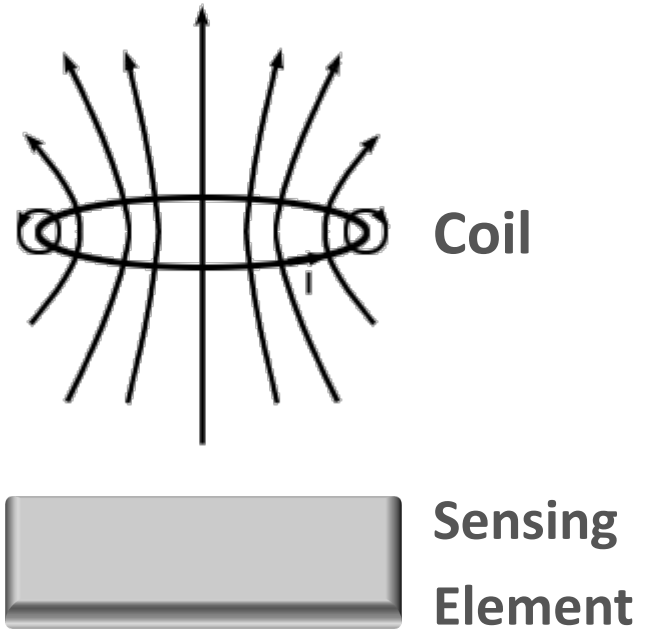


5 pin Magnetic Sensor w/Tamper



Built-in Self Test Feature and magnetic tempco compensation

- Built-in self test
  - Refers to a coil over the hall sensing element in Si72xx
  - When turned on, it generates a known magnetic field over the sensor
    - Field strength depends on VDD and is not configurable
  - Uses :
    - Final production test
    - Verify operation in field



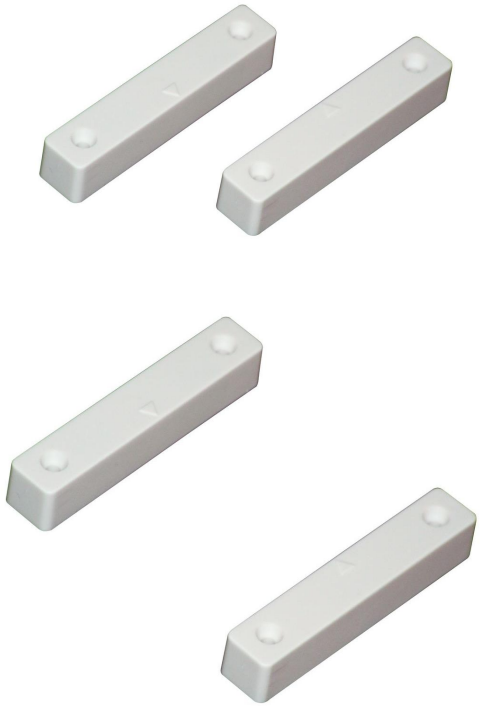
- Magnet temperature compensation
  - Magnets lose field strength with increase in temperature
    - This can cause inaccuracies in position and open/close detection
  - Select Si72xx parts provide built-compensation for this by increasing sensitivity with temperature
  - Compensation available for Ceramic and Neodymium magnets.

The I2C configurability advantage

Typical Magnetic Sensor		Si7210 I2C Magnetic Sensor
Fixed Threshold	→	Re-Programmable threshold
Fixed Output	→	Configurable output
No ability to reconfigure/calibrate	→	Calibrate system in final test/in field
mA's of power for positon sensing	→	nA's of power for position sensing

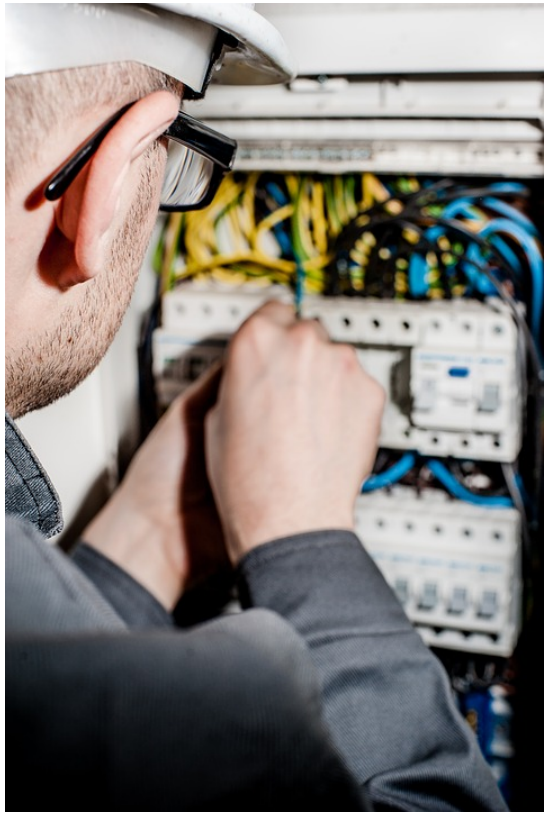
Si7210 I2C magnetic sensors let you develop, test and deploy your products better, cheaper and faster!

Examples of configurability benefits



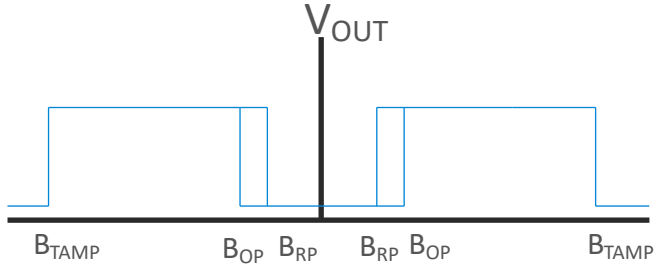
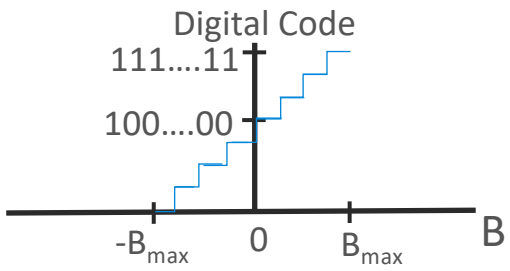
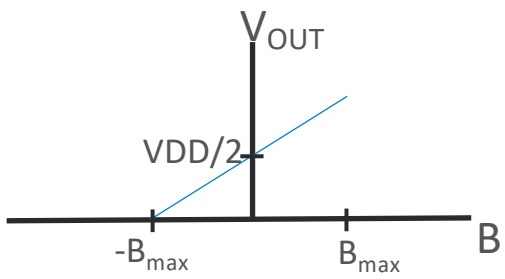
- Enables self install
- Flexibility with locations, placement

- One electrical design, multiple uses
- Reconfigure settings over I2C for different products



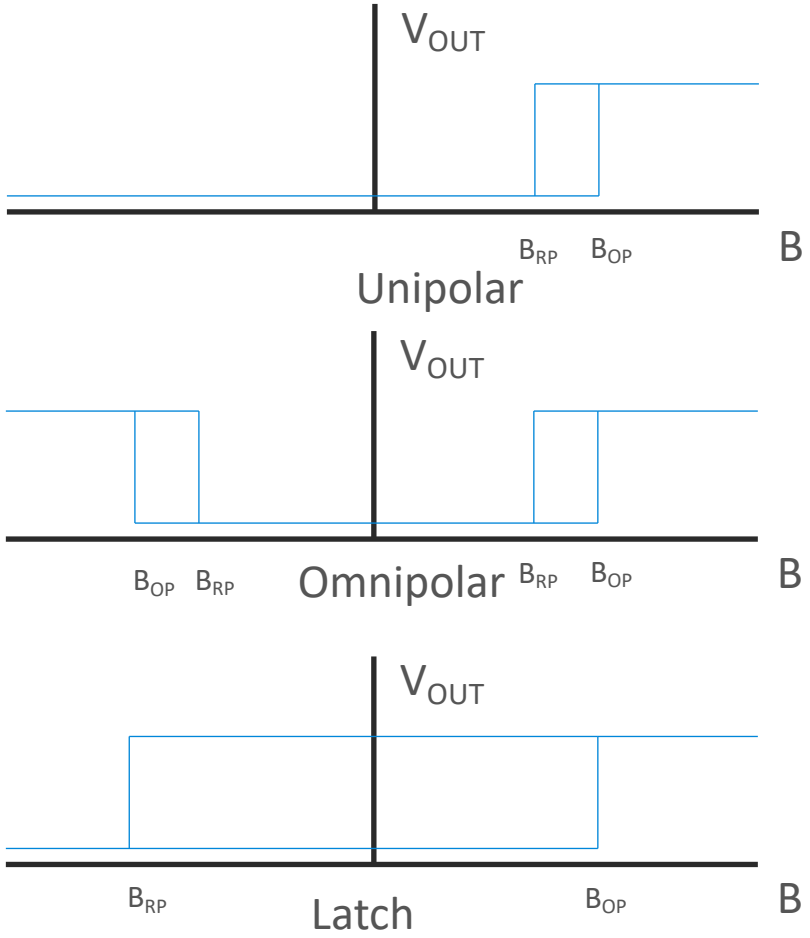
- Debug service call remotely
- Automated in-field performance validation

Si72xx Portfolio

SI720X SERIES	SI7210 SERIES	SI721X SERIES
Digital On/Off Output ✓ Tamper detection ✓ Onmipolar and Latch Outputs ✓ HV and LV options	All the features of Si720x/Si721x, plus… ✓ Built-in Self Test mode ✓ Configure device over I2C ✓ Read device over I2C ✓ Built-in temp sensor	Linear Output ✓ Supports multiple protocols: Analog/SENT/PWM ✓ Digital Interrupt Available ✓ HV and LV Options
 Omni-polar sensor with tamper	 I2C Output	 Analog Output

Si720x Family Features

- Digital Output Types
  - Unipolar
  - Omnipolar (immune to backwards magnet placement)
  - Latch
- Multiple Bop thresholds available
- With and without tamper protection

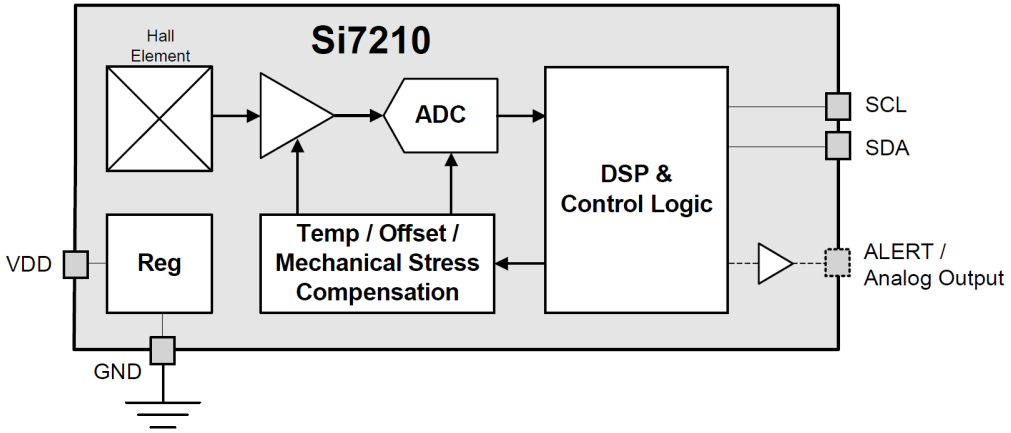


Bop = Trip threshold

Brp = Release threshold

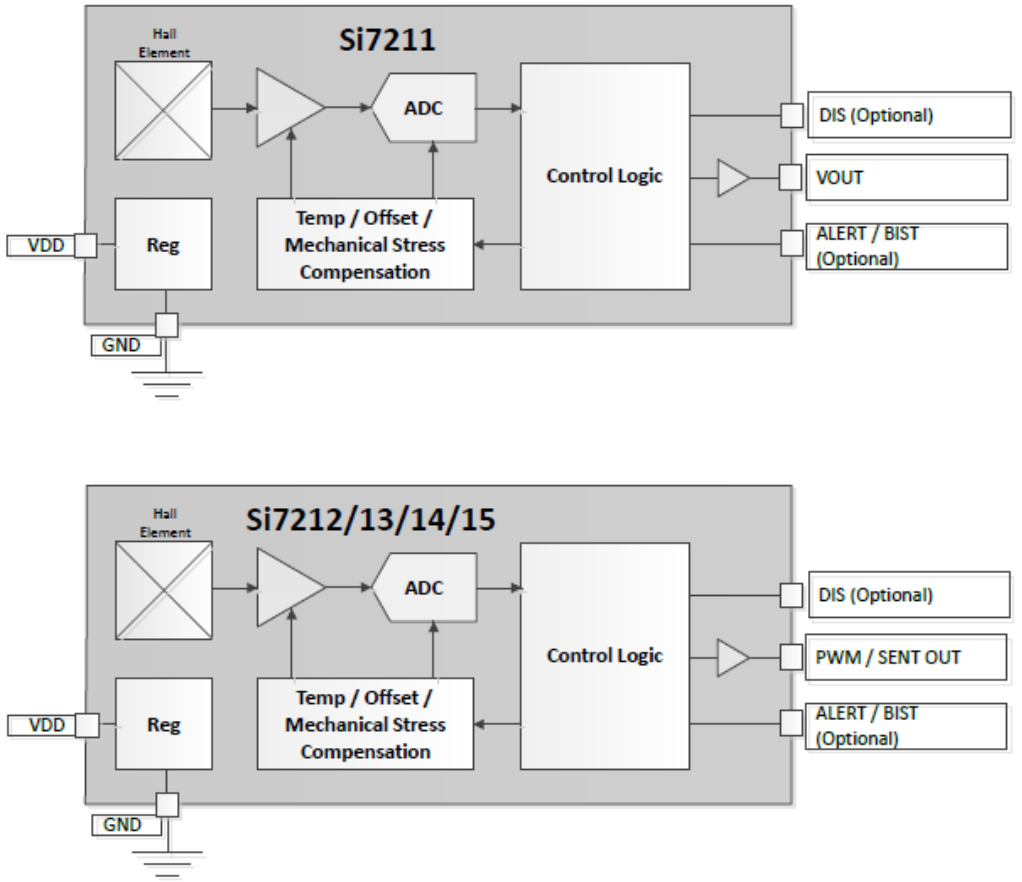
Si7210 Family Features

- Unique Features
  - High 12-bit resolution and ±0.1% output linearity
  - Integrated 1.0°C temperature sensor
- Factory Programmed features
  - I2C addresses (4 available)
  - Sleep time (1ms to 200 ms)
  - Output type (for 5th pin) : Open collector/Push-Pull/Analog
- I2C Configurable
  - Measurement range
  - Digital Filtering
  - Idle Time
  - Operate and release points
  - Omnipolar or Unipolar Output
  - Field polarity (into or out of package)
  - Tamper threshold
  - BIST coil



Si721x Family Features

- Output Types:
  - Analog (proportional to VDD)
  - PWM
  - SENT (Single Edge Nibble Transmission)
- 20mT and 200mT full scale ranges available
- High Performance
  - ±0.15% Total Harmonic Distortion
  - < 30µT RMS noise

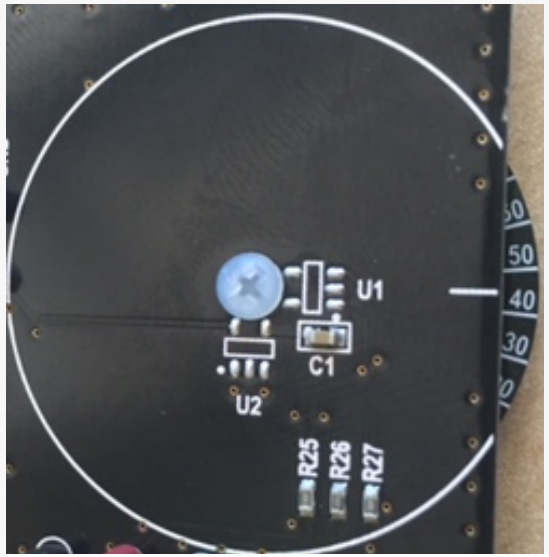


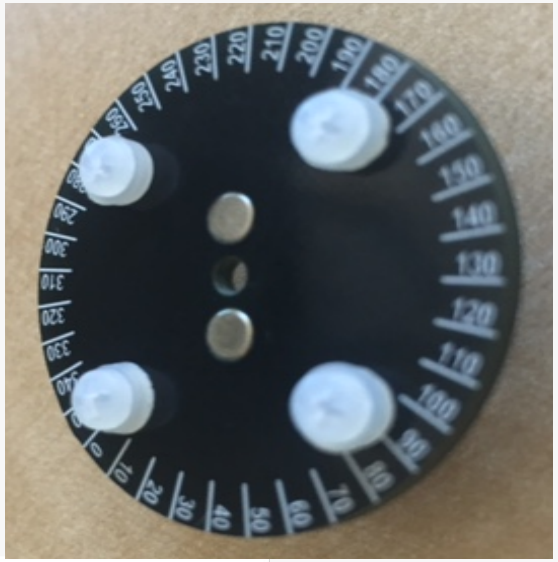
Open/Close Sensing Applications

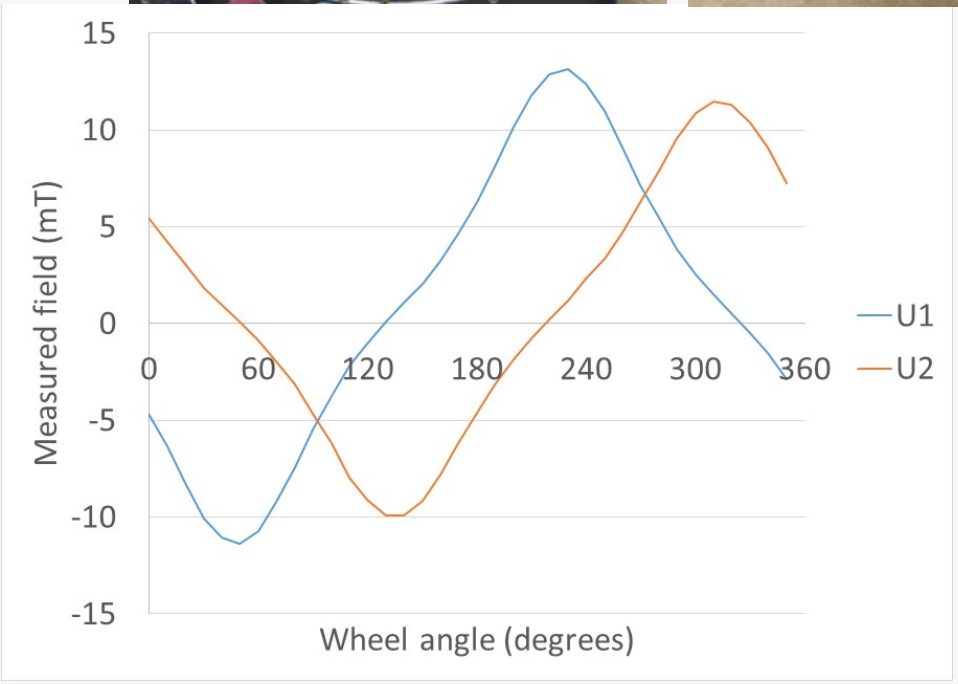
METERING	WHITE GOODS	CONNECTED HOME	CONSUMER ELECTRONICS
Tamper detection Lid Open/Close Flow Sensing	Appliance door Appliance dial Selector knobs	Door open/close detection Window security detection Door locks	Tablet cover Phone covers Proximity detection Lid Open/close

Rotary decoder for angular position sensing

- Two Si7210 parts are placed at 90° offset from the wheel center.
- The parts are on the same bus with unique I2C addresses
- Two magnets are placed at 180 ° from the wheel center
- The magnets and sensors are spaced such that the magnetic field varies approximately as a sinusoid as the wheel is turned.







Position Sensing Applications

MOTOR CONTROL	HOME AUTOMATION	CONSUMER ELECTRONICS	FLUID
Speed Sensing Motor position Safety systems	Dial positon Mechanical button replacement	Joystick Dials Rotary encoders	Coffee maker Industrial monitoring

Example Application: Door/Window Sensor

SI72xx Feature	Product Benefit
Ultra low power(400nA)	Long Battery Life with small battery
Solid state sensor with industrial grade quality	Reliability
High Sensitivity(1.1mT Bop)	Simplified Installation, smaller magnet
I2C Configurability, Built in Self Test	In field calibration, simplified product test
Tamper Detection	Enhanced security against thieves

Example Application: Cordless drill

Selector Gear/Knob position

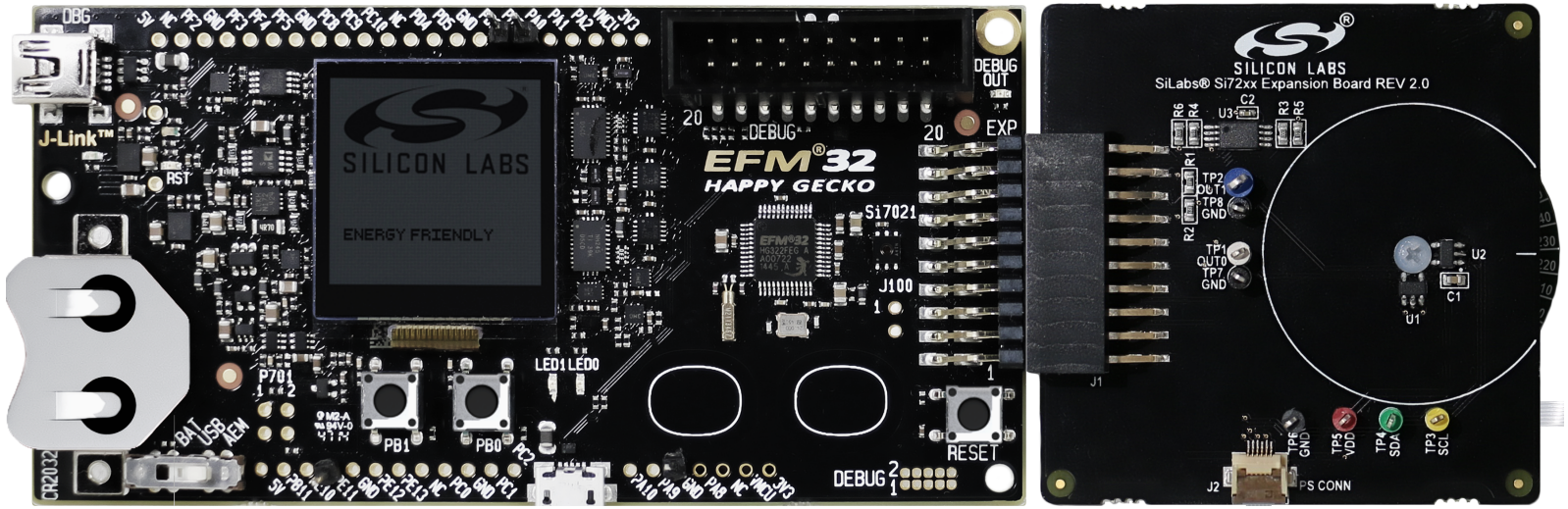
Monitor Motor Speed

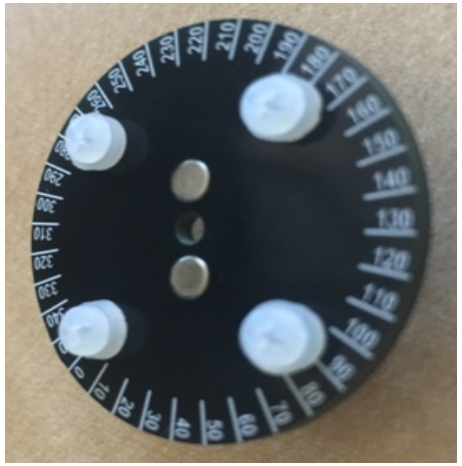
Detect or validate different battery packs

SI72xx Feature	Product Benefit
Ultra low power(400nA)	Long Battery Life with small battery
Solid state sensor with industrial grade quality	Reliability
High Sensitivity	Accurate rotary position detection
Built in Self Test Coil	Simplify final product test
I2C configurability	Support for new tool heads/chucks

Si72xx-WD-KIT

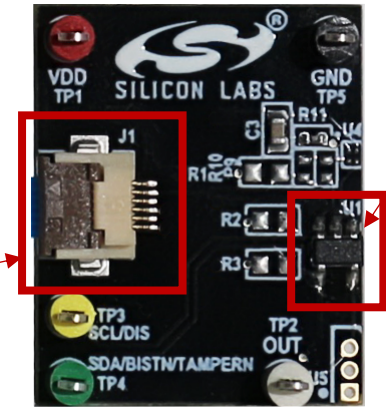
- Showcases degree-accurate rotational positon sensing and low power
- Uses Silicon Labs Happy Gecko Cortex-M0+ MCU
- Low power quadrature decode

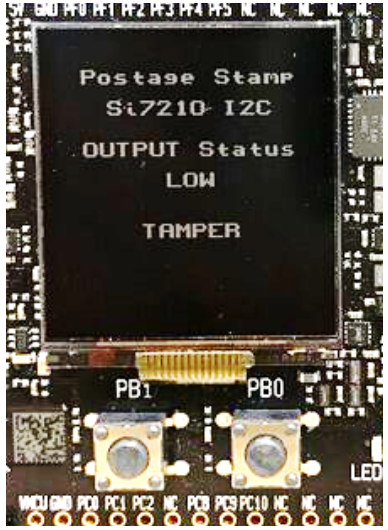


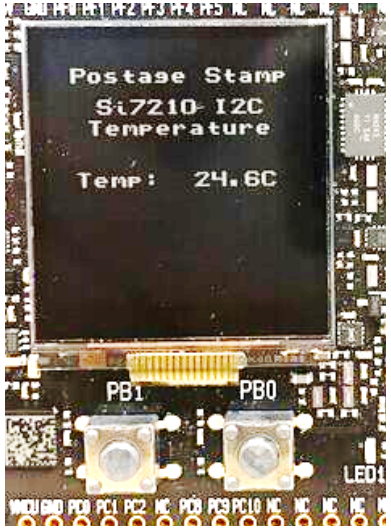


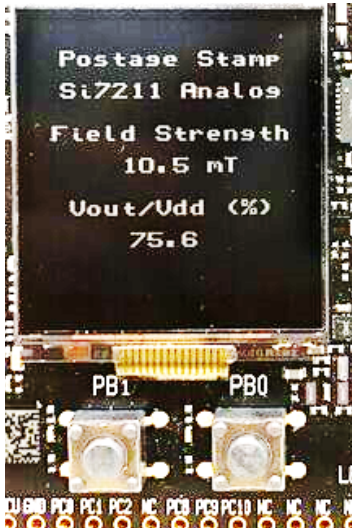
Si72xx-EVAL-KIT

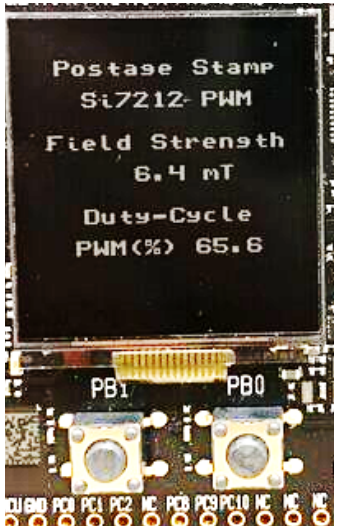
- The Si72xx-EVAL-KIT includes six “postage stamp” boards
  - Connect to wheel board to evaluate multiple products
- Refer to UG288 for more details

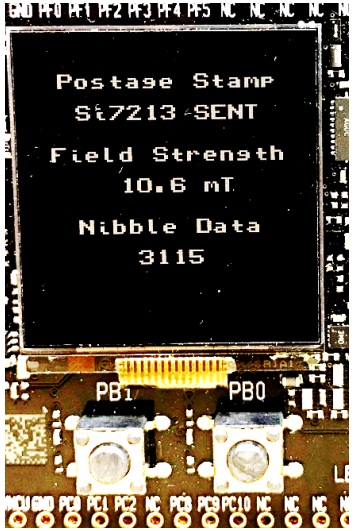


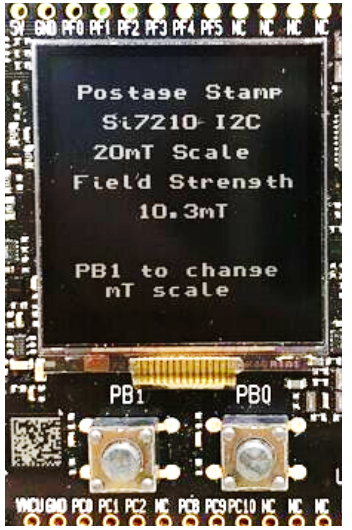








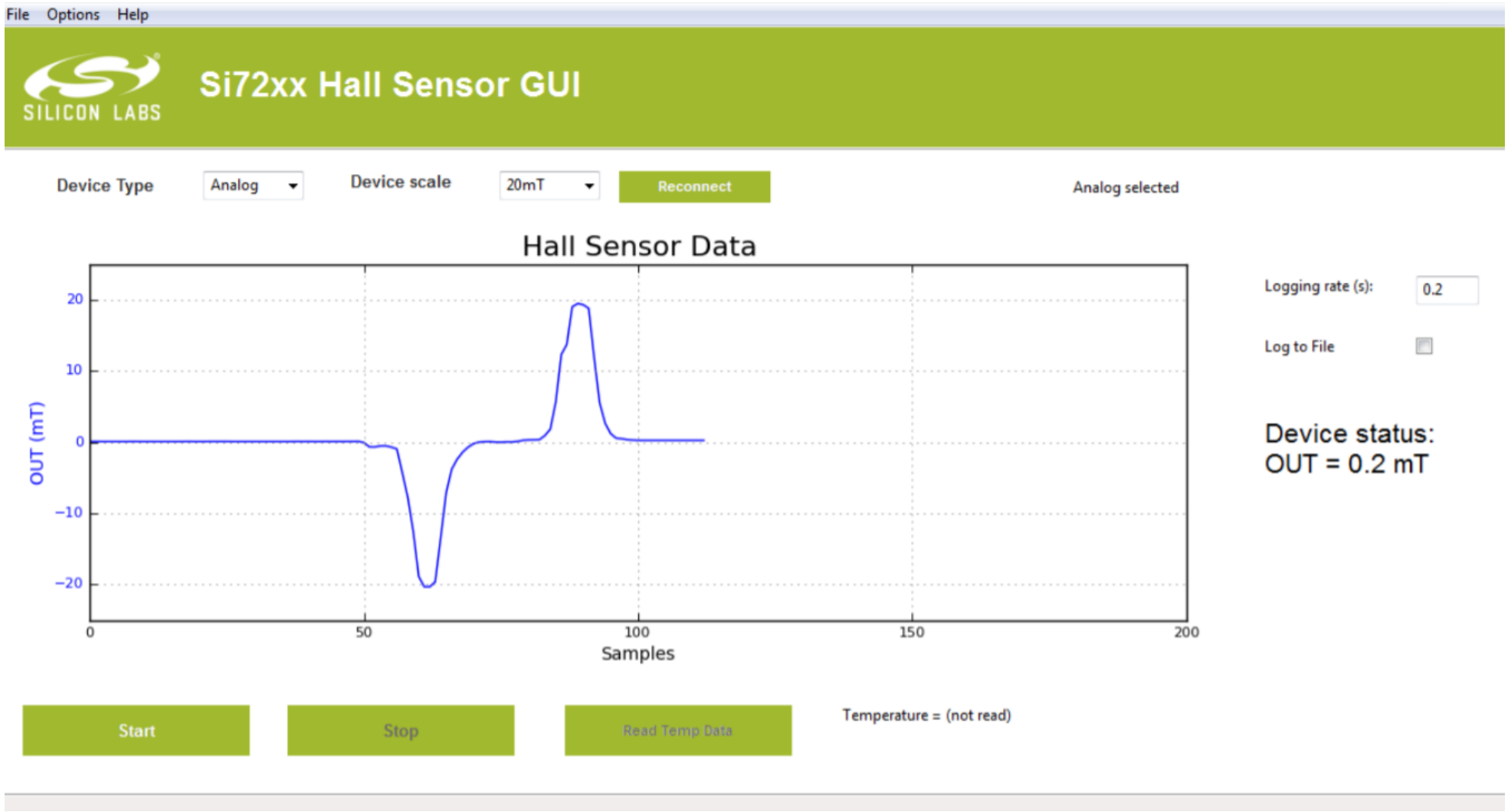




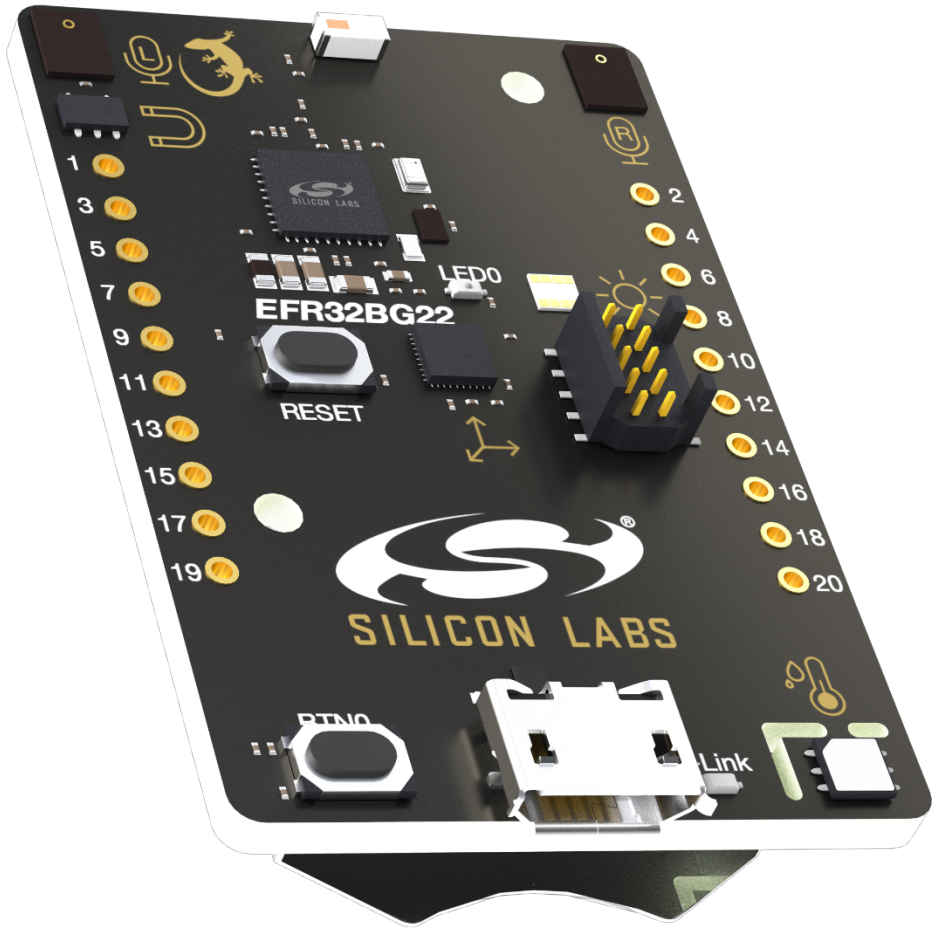
Summary

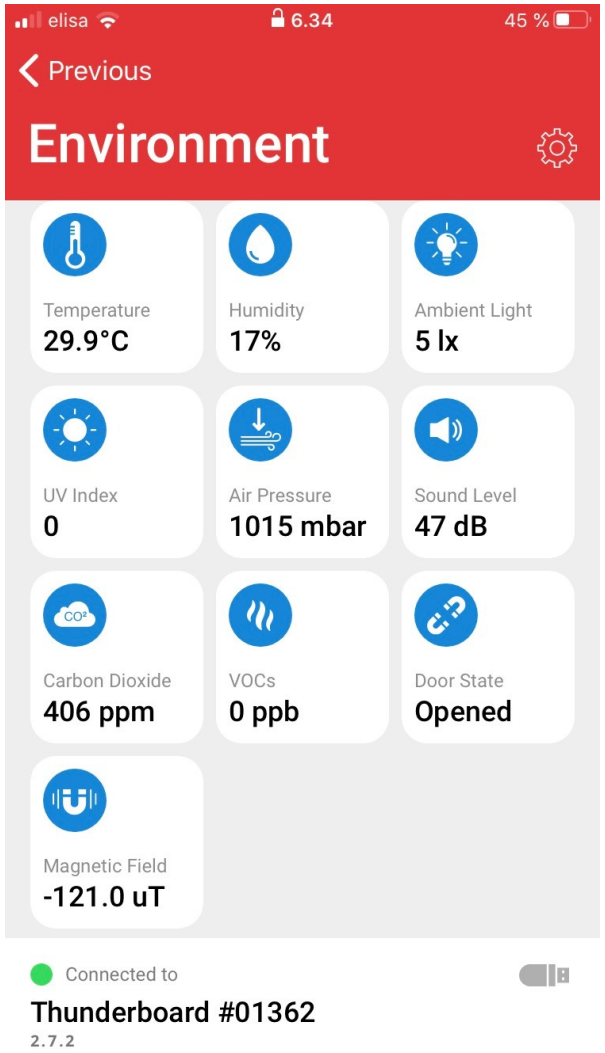
- A complete portfolio of magnetic sensing solutions
  - Switch/Latch devices
  - I2C Programmable Devices
  - Linear Output Devices (I2C/Analog/PWM/SENT)
- Combines high sensitivity, low power and reliability in one single device
  - Save power and magnet size/cost
- Advanced features
  - I2C configurability
  - Tamper detection
  - Built-in self test
  - Temperature sensor

Demo: EVB GUI


File Options Help
SILICON LABS
Si72xx Hall Sensor GUI
Device Type
Analog
Device scale
20mT
Reconnect
Analog selected
Hall Sensor Data
OUT (mT)
20
10
0
−10
−20
0
50
100
150
200
Samples
Logging rate (s):
0.2
Log to File
Device status:
OUT = 0.2 mT
Start
Stop
Read Temp Data
Temperature = (not read)

Demo: Thunderboard





BG22 Virtual Workshop

Learn how to develop and deploy more powerful, efficient, and secure IoT products with your own BG22 Thunderboard – free for all registrants!

New Session Open for July 28th – 30th

10:00AM –11:30 AM CST - T, W, Th

Register today! https://www.silabs.com/about-us/events/virtual-bluetooth-workshop

works with
BY SILICON LABS

VIRTUAL CONFERENCE

The Largest Smart Home Developer Event

SEPTEMBER 9–10, 2020

Immerse yourself in two days of technical training designed especially for engineers, developers and product managers. Learn how to "Work With" ecosystems including Amazon and Google and join hands-on classes on how to build door locks, sensors, LED bulbs and more.

Don't miss out, register today!

workswith.silabs.com

Thank you

WWW.SILABS.COM

References and useful Hall-Effect Sensor links

- Product page: https://www.silabs.com/sensors/magnetic
- Selector guide: https://www.silabs.com/documents/public/brochures/magnetic-sensors-selector-guide.pdf
- Eval Kit: https://www.silabs.com/products/development-tools/sensors/si72xx-eval-kit-magnetic-evaluation-kit
  - User's guide: https://www.silabs.com/documents/public/user-guides/ug345-si72xx-eval-kit.pdf
- Development kit: https://www.silabs.com/products/development-tools/sensors/si72xx-magnetic-development-kit
  - User's guide: https://www.silabs.com/documents/public/user-guides/ug288-si7200evb.pdf
- Design considerations: https://www.silabs.com/documents/public/application-notes/an1018-si72xx-sensors.pdf
- Thunderboard: https://www.silabs.com/products/development-tools/thunderboard/thunderboard-bg22-kit