INTRODUCTION

Target Applications

- Industrial Sensor Node
- Drone

Application example: Industrial Sensor Node

- Power Supply Unit
  - Gate Battery
  - Lithium Polymer Battery
- Sensor Unit
  - Wireless Module BLE/2.4GHz
  - LED
  - Low Power IC, MCU
- Network
  - Network Interface
  - Sensors
    - Accelerometer
    - Gyroscope
    - Magnetometer
    - Pressure
    - Light
    - Current
    - Temperature

Application example: Drone

Range of ROHM’s Analog ICs for Power Management

- MEMS SENSORS
- MAGNETIC SENSORS
- OPTICAL SENSORS
- LASER DIODES
- LOW POWER MCU
- WIRELESS COMMUNICATION
- POWER DELIVERY
MEMS SENSORS - ACCELEROMETERS

Kionix, a 100% member of ROHM group, supplies a wide range of accelerometers optimized for a variety of applications. Ultra-low current consumption combined with improved shock resistance and superior temperature characteristics result in industry-leading* performance. In addition, various detection algorithms are offered, including motion wake-up and step counter (pedometer).

**Accelerometer / Target Applications / Product Map**

<table>
<thead>
<tr>
<th>Market</th>
<th>Target Application</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging Consumer</td>
<td>Key Fob (Power Save)</td>
<td>KX112-1042</td>
</tr>
<tr>
<td></td>
<td>Smart Card (Power Save, Motion Input)</td>
<td>KXJCB-1041</td>
</tr>
<tr>
<td></td>
<td>Smart Audio (Power Save, Motion Input)</td>
<td>KX127*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KX132</td>
</tr>
<tr>
<td></td>
<td>(Consumer Version)*</td>
<td></td>
</tr>
<tr>
<td>Proven Records</td>
<td>Vehicle Shaft Sensor (Vibration)</td>
<td>KXTJ3-1052</td>
</tr>
<tr>
<td></td>
<td>Inertial Sensor (Inclination)</td>
<td>KX122-1037</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KX124-1051</td>
</tr>
<tr>
<td></td>
<td>Inertial Sensor (Inclination)</td>
<td>KX126-1063</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KXRox/KXDxx</td>
</tr>
<tr>
<td>Non-Safety Automotive</td>
<td>Head Light Levelizer (Attitude)</td>
<td>KX123-6000</td>
</tr>
<tr>
<td></td>
<td>Active Suspension (Vibration)</td>
<td>KX023*</td>
</tr>
<tr>
<td></td>
<td>Active Noise Canceller (Vibration)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anti-Theft-E-Call (Attitude, Call)</td>
<td>KX132</td>
</tr>
<tr>
<td></td>
<td>(Automotive Version)*</td>
<td></td>
</tr>
<tr>
<td>Appliance &amp; Industrial</td>
<td>Machine Health Monitor (Vibration)</td>
<td>KX222-1054</td>
</tr>
<tr>
<td></td>
<td>Sports (Motion Track, Shock)</td>
<td>KX224-1053</td>
</tr>
<tr>
<td></td>
<td>Fitness, Healthcare (Motion, Shock)</td>
<td>KX220</td>
</tr>
<tr>
<td></td>
<td>Appliance e.g. Washer (Vibration)</td>
<td>KMX63/65</td>
</tr>
<tr>
<td></td>
<td></td>
<td>KX132</td>
</tr>
<tr>
<td></td>
<td>(Industrial Version)*</td>
<td>KX134/135*</td>
</tr>
</tbody>
</table>

* Under Development

**Accelerometer / Line-up**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Uniqueness Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>KXTJ3-1057</td>
<td>Standard Low Cost 2x2mm</td>
</tr>
<tr>
<td>KX122-1037</td>
<td>Standard 2x2mm</td>
</tr>
<tr>
<td>KX124-1051</td>
<td>Standard 3x3mm</td>
</tr>
<tr>
<td>KX023</td>
<td>Low Height 2x2x0.6mm</td>
</tr>
<tr>
<td>KX122-1042</td>
<td>Low Height 2x2x0.6mm</td>
</tr>
<tr>
<td>KXJCB-1041</td>
<td>Low Height 3x3x0.45mm</td>
</tr>
<tr>
<td>KX126-1063</td>
<td>Step Count</td>
</tr>
<tr>
<td>KX03x</td>
<td>Step Count (Different pin-out)</td>
</tr>
<tr>
<td>KX222-1054</td>
<td>Higher-G ±32g 2x2mm</td>
</tr>
<tr>
<td>KX224-1053</td>
<td>Higher-G ±32g 3x3mm</td>
</tr>
<tr>
<td>KM062-1031</td>
<td>Combo. Accel(±16g) + Mag</td>
</tr>
<tr>
<td>KM063-1055</td>
<td>Combo. Accel(±4g) + Mag</td>
</tr>
<tr>
<td>KX94</td>
<td>Low Noise Analog - ±2g (Factory Programmed up to ±4g)</td>
</tr>
<tr>
<td>KX220</td>
<td>Analog up to ±20g / Analog up to ±40g</td>
</tr>
<tr>
<td>KXT9</td>
<td>Analog ±2g (Factory Programmed up to ±5g)</td>
</tr>
<tr>
<td>KX123-6000</td>
<td>Low Power ABC-Q100 (Automotive)</td>
</tr>
<tr>
<td>KX03x</td>
<td>Stability Accelerometer (Industrial)</td>
</tr>
<tr>
<td>KX132</td>
<td>Low power Step Count with Freq. INT (Consumer)</td>
</tr>
<tr>
<td>KX132</td>
<td>Low power Step Count with Freq. INT (Industrial &amp; Automotive)</td>
</tr>
<tr>
<td>KX134</td>
<td>Higher Bandwidth with Freq. INT (Industrial)</td>
</tr>
<tr>
<td>KX136</td>
<td>Higher-G ±50g with Freq. INT</td>
</tr>
</tbody>
</table>

MP = Mass Production / UD = Under Development / S = Sampling

These days, many devices around us are linked to other devices in a variety of ways, and this situation is only expected to expand in the future to meet the needs for lower costs, greater energy savings, and increased convenience. ROHM’s broad semiconductor portfolio provides all necessary components for such connected IoT devices. This includes Ultra-Low Power MCUs, Wireless communication devices from sub-GHz to the 2.4GHz band as well as Power Management technologies to ensure efficient power supply for battery driven applications.
MEMS SENSORS - ACCELEROMETERS

Highlight: High G and High Bandwidth Accelerometers

<table>
<thead>
<tr>
<th></th>
<th>XKK223 (2x2mm)</th>
<th>XKK246 (3x3mm)</th>
<th>XKK132 (2x2mm)</th>
<th>XKK154 (2x2mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G-Range</td>
<td>±2g</td>
<td>±3g</td>
<td>±1g</td>
<td>±2g</td>
</tr>
<tr>
<td>Sampling Rate (ODR)</td>
<td>Up to 25,600Hz</td>
<td>Up to 25,600Hz</td>
<td>Up to 25,600Hz</td>
<td>Up to 25,600Hz</td>
</tr>
<tr>
<td>Mechanical Res.</td>
<td>6,000Hz</td>
<td>6,000Hz</td>
<td>3,000Hz</td>
<td>6,000Hz</td>
</tr>
<tr>
<td>Power (0.1%FS)</td>
<td>±0.8μA</td>
<td>±3.8μA</td>
<td>±1μA</td>
<td>±1μA</td>
</tr>
<tr>
<td>FFO</td>
<td>24B</td>
<td>36B</td>
<td>512B</td>
<td>512B</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-40°C to +85°C</td>
<td>-40°C to +85°C</td>
<td>-40°C to +105°C</td>
<td>-40°C to +105°C</td>
</tr>
<tr>
<td>Embedded Engines</td>
<td>Wake up, Tap,</td>
<td>Wake up, Tap,</td>
<td>Wake up, Tap,</td>
<td>Wake up, Tap,</td>
</tr>
<tr>
<td></td>
<td>Rotation, FreeFall</td>
<td>Rotation, FreeFall</td>
<td>Rotation, FreeFall</td>
<td>FreeFall</td>
</tr>
</tbody>
</table>

Target Applications:
- Machine Health
- Shock Detection
- Higher Frequency Detection
- Sport Trainer

Highlight: XKK03C – High Stability Accelerometer

<table>
<thead>
<tr>
<th></th>
<th>Accelerometer for Industrial &amp; Automotive Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital Interface</td>
<td>I2C/SPI</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>2.4V to 5.5V</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-40 to +125°C</td>
</tr>
<tr>
<td>Package</td>
<td>5x5x1.2mm (DFN)</td>
</tr>
<tr>
<td>G-Range</td>
<td>±2g, ±4g, ±8g, ±16g</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>±0.4μA</td>
</tr>
<tr>
<td>Bandwidth</td>
<td>±0.1g (30°C, 25°C)</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>±0.1mg/°C</td>
</tr>
<tr>
<td>Long Life Support</td>
<td>10 years</td>
</tr>
</tbody>
</table>

KX03x Target Applications:
- Inclinometers
- Level Meters
- IMU
- Long term stability applications
- Tilt Compensation
- Solar Trackers

Digital Barometric Pressure Sensor IC with Built-in Temperature Compensation

ROHM offers piezoresistive-type barometric sensor ICs that carries out internal temperature correction using a proprietary compensation algorithm covering both high and low temperatures, making it easy to obtain high accuracy barometric pressure data.

Features:
- Piezo-resistive pressure sensor
- Detection range: 300hPa to 1,300hPa
- Built-in temperature compensation function
- I2C interface
- Compact Package

Applications:
- Smartphones
- Wearable Devices
- Activity Trackers

Block Diagram
Integrated temperature compensation function results in high accuracy relative pressure (altitude) characteristics, from low to high temperature.

Pressure Measurement Example
Measurement data taken by moving the pressure sensor IC

Digital Barometric Pressure Sensor IC with Built-in Temperature Compensation

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Supply Voltage (V)</th>
<th>Pressure Range (hPa)</th>
<th>Relative Pressure Accuracy (hPa)</th>
<th>Absolute Pressure Accuracy (hPa)</th>
<th>Average Current (μA)</th>
<th>TPF</th>
<th>Operating Temp. (°C)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM1386LV</td>
<td>1.7 to 3.6</td>
<td>300 to 1,300</td>
<td>±0.12</td>
<td>±1</td>
<td>2.3</td>
<td>1/16</td>
<td>-40 to +85</td>
<td>CQUA1640</td>
</tr>
<tr>
<td>BM1388</td>
<td>Waterproof packaging - under development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ROHM offers magnetic sensors based on Hall and MI technology. ROHM’s ultra-compact Hall IC series integrates a high-sensitivity Hall element and processing circuit into a single chip, allowing them to be used to detect the presence of a magnetic field. ROHM’s high sensitive MI based sensors are capable of detecting magnetic fields in 3 directions. The MI sensor features high sensitivity and significantly lower current consumption and noise compared with conventional methods.

**Magnetic Sensors Technologies**

<table>
<thead>
<tr>
<th>Bio magnetic</th>
<th>Natural magnetic</th>
<th>Industrial magnetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>nT</td>
<td>µT</td>
<td>mT</td>
</tr>
</tbody>
</table>

**Highlight:** High Sensitive MI based Geomagnetic Sensor

*Features:*  
- MI-type 3-axis magnetic sensor  
- 12bit/14bit digital output  
- Current consumption: 150μA (Typ. @ 100Hz)  
- Measurable input magnetic field range: ±1.200μT  
- Magnetic sensitivity: 0.042µT/LSB (Typ.)

*Applications:*  
- Wearable Devices  
- Indoor Navigation  
- Electronic Compass  
- Parking Systems  
- Machine Health

**Highlight:** Contactless Current Sensor BM14270MUV-LB

*Features:*  
- Temperature range: -40 to 125°C  
- Measurement range: ±50A  
- 14bit digital output  
- Resolution 0.008A/LSB

*Applications:*  
- Power meter  
- Power conditioner  
- UPS

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**Magnetic Field Sensor IC**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Supply Voltage (V)</th>
<th>Current Consumption (µA)</th>
<th>Magnetic Field (µT/LSB)</th>
<th>Input Magnetic Field Range (µT)</th>
<th>Operating Temperature (°C)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BM1422AGMV</td>
<td>1.7 to 3.6</td>
<td>150</td>
<td>0.042</td>
<td>±1,200</td>
<td>-40 to +85</td>
<td>MLGA01V020A</td>
</tr>
</tbody>
</table>

---

**Highlight:** Ultra compact Hall Sensor line-up

ROHM offers Hall sensors in ultra compact packages. Sensitivity is widely selectable from high (2.4mT) to very low (43mT) to suit to several applications and distance from magnet.

<table>
<thead>
<tr>
<th>rop(mT)</th>
<th>1.1x1.4x0.4mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>High Accuracy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>rop(mT)</th>
<th>0.8x0.8x0.4mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
</tr>
<tr>
<td>High Accuracy Noise Resistance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>rop(mT)</th>
<th>0.65x0.65x0.33mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
</tr>
</tbody>
</table>

---

**New:** Contactless Current Sensor BM14270MUV-LB

*Features:*  
- Temperature range: -40 to 125°C
- Measurement range: ±50A
- 14bit digital output
- Resolution 0.008A/LSB

*Applications:*  
- Power meter  
- Power conditioner  
- UPS

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**Coreless current sensor using MI (Magnetic Impedance) sensor**

[Diagram showing coreless current sensor using MI (Magnetic Impedance) sensor]
Ambient Light and Proximity Sensors

ROHM offers magnetic sensors based on Hall and MI technology. ROHM Ambient Light sensors feature optical characteristics close to the human eye, enabling automatic backlight adjustment in displays for lower power consumption and optimum visibility.

Features:
• Broad lineup includes current output analog and 16bit serial digital ambient light sensor ICs
• Compatible with a variety of light sources
• Wide light detection range

Applications:
• Tablets
• Notebook PCs
• LCD Displays
• Digital Cameras
• Display-equipped Devices

Analog Current Output type Ambient Light Sensor ICs

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Supply Voltage (V)</th>
<th>Sensitivity Variation (%)</th>
<th>Brightness Measurement (lx)</th>
<th>High Sensitivity</th>
<th>IR Cut</th>
<th>Operating Temp. (°C)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH1603FVC</td>
<td>2.4 to 5.5</td>
<td>±15</td>
<td>0 to 100,000</td>
<td>–</td>
<td>–</td>
<td>-40 to +85</td>
<td>WSOF6</td>
</tr>
<tr>
<td>BH1620FVC</td>
<td>2.4 to 5.5</td>
<td>±15</td>
<td>0 to 100,000</td>
<td>–</td>
<td>–</td>
<td>-40 to +85</td>
<td>WSOF5</td>
</tr>
<tr>
<td>BH1680FVC</td>
<td>2.4 to 5.5</td>
<td>±15</td>
<td>0 to 50,000</td>
<td>✔</td>
<td>✔</td>
<td>-40 to +85</td>
<td>WSOF5</td>
</tr>
<tr>
<td>BH1682FVC</td>
<td>2.3 to 5.5</td>
<td>±3µA</td>
<td>0 to 55,000</td>
<td>✔</td>
<td>✔</td>
<td>-40 to +85</td>
<td>WSOF5</td>
</tr>
</tbody>
</table>

Digital 16bit Serial Output type Ambient Light Sensor ICs

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Supply Voltage (V)</th>
<th>Sensitivity Variation (%)</th>
<th>Brightness Measurement (lx)</th>
<th>High Sensitivity</th>
<th>IR Cut</th>
<th>Operating Temp. (°C)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH1721FVC</td>
<td>2.4 to 3.8</td>
<td>±15</td>
<td>0 to 80,000</td>
<td>–</td>
<td>–</td>
<td>-40 to +85</td>
<td>WSOF5</td>
</tr>
<tr>
<td>BH1730FVC</td>
<td>2.4 to 3.6</td>
<td>±15</td>
<td>0 to 80,000 (1/128 lx step)</td>
<td>✔</td>
<td>–</td>
<td>-40 to +85</td>
<td>WSOF5</td>
</tr>
<tr>
<td>BH1728NVC</td>
<td>2.3 to 3.6</td>
<td>±15</td>
<td>0 to 80,000 (1/512 lx step)</td>
<td>✔</td>
<td>✔</td>
<td>-40 to +85</td>
<td>WSON008X2120</td>
</tr>
</tbody>
</table>

Highlight: High Sensitivity Ambient Light Sensor BH1726NVC

Features:
• Built-in IrCut filter
• High sensitivity: 0.0003lx/count(max setting)
• 2 outputs with different spectrum response
• Usable with dark window
• 50/60Hz light noise reject function
• I2C Interface
• Interrupt function
• Supply voltage: 2.3 ~ 3.6V
• Current consumption: 75µA

Highlight: Optical Sensor for Heart Rate Monitor

ROHM’s optical heart rate sensor ICs integrate an optical filter optimized for pulse detection in the sensor block to minimize the effects of ambient light such as infrared and red rays. This makes it possible to obtain high quality pulse signals, even outdoors. The BH1792GLC features high-speed 1024Hz sampling that allows it to measure complex vital signs such as stress and vascular age.

Features:
• Superior noise removal characteristics
• Low power consumption
• High-speed 1024Hz sampling (BH1792GLC)

Applications:
• Earphone
• Wearable Devices
• Tablets
• Smart Watches

Optical Sensor for Heart Rate Monitor IC

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Analog Supply Voltage (V)</th>
<th>I2C Supply Voltage (V)</th>
<th>Sampling Frequency (Hz)</th>
<th>Red/Infrared Cut</th>
<th>I/F</th>
<th>Operating Temp. (°C)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH1790GLC</td>
<td>2.5 to 3.6</td>
<td>1.7 to 3.6</td>
<td>32/64</td>
<td>✔</td>
<td>PC</td>
<td>-20 to +85</td>
<td>WLGA010V28</td>
</tr>
<tr>
<td>BH1792GLC</td>
<td>2.5 to 3.6</td>
<td>1.7 to 3.6</td>
<td>32/64/128/256/1024</td>
<td>✔</td>
<td>PC</td>
<td>-20 to +85</td>
<td>WLGA010V28</td>
</tr>
</tbody>
</table>

Highlight: 3-in-1 Proximity Ambient Light Sensor

ROHM’s 3-in-1 proximity ambient light sensor combines an infrared LED, brightness sensor, and proximity sensor into a single package. It is designed to improve visibility and reduce set power consumption.

Features:
• Integrated package
• Digital output (I2C interface)

Applications:
• Smartphones, Tablets
• Digital Cameras
• Home Appliance

ALS/Proximity Sensor with Infrared LED

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Supply Voltage (V)</th>
<th>Sensitivity Variation (%)</th>
<th>Brightness Measurement (lx)</th>
<th>High Sensitivity</th>
<th>IR Cut</th>
<th>I/F</th>
<th>Operating Temp. (°C)</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPR-0521R</td>
<td>2.5 to 3.8</td>
<td>±40</td>
<td>0 to 43,000</td>
<td>✔</td>
<td>–</td>
<td>PC</td>
<td>25 to +85</td>
<td>SON</td>
</tr>
</tbody>
</table>
**OPTICAL SENSORS**

**Highlight: Color RGB Sensor IC**

ROHM color sensor IC leverage original infrared removal technology and calculation methods to achieve the industry’s highest infrared rejection characteristics. Unlike conventional color sensor IC, brightness and color temperature can be detected even in dark (low transmittance) optical windows that make accurate detection difficult due to infrared rays.

**Features:**
- Not susceptible to infrared rays
- Broad light detection range: (0 to 80,000lx)
- High accuracy brightness and color temperature detection even with dark optical windows

**Applications:**
- Tablets
- Notebook PCs
- LCD Displays
- Digital Cameras
- Display-equipped Devices

**Highlight: High Output Laser Diodes**

ROHM high power laser diodes are optimized for a variety of applications, including motion sensing and dust measurement.

**Features:**
- 800-900nm IR for Motion detection
  - High 200mW output
  - Kink-free via CW drive
  - High efficiency operation with excellent temperature characteristics
  - MTTF>40,000hrs at 200mW (+60°C) drive

- 660nm for PM1.0/PM2.5/Dust Detector
  - Higher resistance against destruction
  - High ESD (=Electro Static Discharge)
  - Optimized optical characteristics
  - Good Temperature Characteristics
  - High reliability – Long Lifetime

**Part No.**
- RLD63NPC5
- RLD63NPC7
- RLD63NPC8
- RLD63MX1
- RLD63PZ2
- RLD63NZX1
- RLD63NZX2
- RLD63NZX3
- RLD63NZM5
- RLD63PZ3
- RLD63NZ2
- RLD63PZ4
- RLD63NZM7
- RLD63PZ1
- RLD63NZ1
- RLD63PZ2
- RLD63NZ2
- RLD63PZ3
- RLD63NZ3
- RLD63PZ4
- RLD63NZ4
- RLD63PZ5
- RLD63NZ5
- RLD63PZ6
- RLD63NZ6
- RLD63PZ7
- RLD63NZ7
- RLD63PZ8
- RLD63NZ8
- RLD63PZ9
- RLD63NZ9
- RLD63PZ10
- RLD63NZ10
- RLD63PZ11
- RLD63NZ11
- RLD63PZ12
- RLD63NZ12

**Spectral Sensitivity (BH1749NUC)**

**Color Temperature Detection Comparison Under Dark Optical Windows**

**16bit Serial Output type Digital Color Sensor IC**

**Part No.**
- BH1749NUC

**Wavelength**
- Red (630nm)
- Green (540nm)
- Blue (460nm)

**High Sensitivity**
- IR Cut: PC
- Operating Temp. (°C)
- Package: WSON008X2120

**Part No.**
- RLD63NPC5
- RLD63NPC7
- RLD63NPC8
- RLD63MX1
- RLD63PZ2
- RLD63NZX1
- RLD63NZX2
- RLD63NZX3
- RLD63NZM5
- RLD63PZ3
- RLD63NZ2
- RLD63PZ4
- RLD63NZM7
- RLD63PZ1
- RLD63NZ1
- RLD63PZ2
- RLD63NZ2
- RLD63PZ3
- RLD63NZ3
- RLD63PZ4
- RLD63NZ4
- RLD63PZ5
- RLD63NZ5
- RLD63PZ6
- RLD63NZ6
- RLD63PZ7
- RLD63NZ7
- RLD63PZ8
- RLD63NZ8
- RLD63PZ9
- RLD63NZ9
- RLD63PZ10
- RLD63NZ10
- RLD63PZ11
- RLD63NZ11
- RLD63PZ12
- RLD63NZ12
LOW POWER MCU

ROHM/LAPIS Semiconductor offers a large selection of ultra low power MCUs based on proprietary low power technology. The low power consumption and a large set of peripherals like embedded LCD drivers, sound playback or encryption functions make them the perfect choice for any battery operated application.

Highlight: 16bit Low Power MCU Series

Features:
• Multiple power down modes
• Extensive peripherals

Applications:
• Sensor Nodes, Wireless Modules, etc.
• Battery Powered Devices Such as Electronic Shelf Labels
• Consumer Electronics, Home Appliances, Industrial Equipment

Standard 16bit U16 Core Low Power MCUs

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Operating Conditions</th>
<th>ROM/RAM</th>
<th>Functions/Features Package</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML620Q503H</td>
<td>1.8</td>
<td>Low Speed: 32MHz, High Speed: 16MHz</td>
<td>36/32/64</td>
<td>128x16/16x16</td>
</tr>
<tr>
<td>ML620Q504H</td>
<td>1.8</td>
<td>Low Speed: 32MHz, High Speed: 16MHz</td>
<td>36/32/64</td>
<td>128x16/16x16</td>
</tr>
</tbody>
</table>

32bit Low Power MCUs with Built-In ARM® Cortex®-M0+ and USB/LCD Drivers

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Operating Conditions</th>
<th>ROM/RAM</th>
<th>Functions/Features Package</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML630Q464/503</td>
<td>1.8</td>
<td>Low Speed: 32MHz, High Speed: 16MHz</td>
<td>36/32/64</td>
<td>128x16/16x16</td>
</tr>
<tr>
<td>ML630Q466</td>
<td>1.8</td>
<td>Low Speed: 32MHz, High Speed: 16MHz</td>
<td>36/32/64</td>
<td>128x16/16x16</td>
</tr>
</tbody>
</table>

WIRELESS COMMUNICATION

Lapis provides several RF communication product including low power sub-GHz RF Communication ICs as well as Bluetooth LE ICs:
• SubGHz RF is ideal for data collection and device control applications because they are less sensitive to obstacles like walls. So a single device can cover a larger area compared to 2.4GHz solutions.
• Bluetooth LE is a well established standard for short range connection of battery driven sensor devices.

All Wireless communication products from LAPIS Semiconductor are «Low Power»:
• Low Power Radio extend battery lifetime, smaller battery enable smaller form factor
• Accumulated know-how thanks to in-house design RF circuit blocks
• System level design partitioning enables effective average current

Highlight: Bluetooth LE Solutions

Features:
• Bluetooth® low energy single mode compatible modules
• Bluetooth® core spec. v4.x compliant
  v4.0: MK71050-03
  v4.1: MK71251-01, MK71251-02
• Low power consumption ideal for coin/button battery devices:
  6.7mA during transmission, 6.2mA during reception (MK71251-01/MK71251-02)
• Integrates LAPIS Semiconductor’s LSI
• Wireless characteristics pre-adjusted before shipment
• Radio Law/FCC/IC/CE certified with built-in antenna

Bluetooth® Modules

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Operating Conditions</th>
<th>Host CPU</th>
<th>Compliant Standards</th>
<th>Module Specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>MK71050-03</td>
<td>25 to 70</td>
<td>B4D*65RI-5 UART</td>
<td>Bluetooth® core spec. v4.0 (Single mode)</td>
<td>Role: Master/Slave, No. of Connected Devices: 1</td>
</tr>
<tr>
<td>MK71251-01</td>
<td>25 to 75</td>
<td>B4D*65RI-5 UART</td>
<td>Bluetooth® core spec. v4.1 (Single mode)</td>
<td>Role: Slave only, No. of Connected Devices: 2</td>
</tr>
<tr>
<td>MK71251-02</td>
<td>25 to 75</td>
<td>UART</td>
<td>Bluetooth® core spec. v4.1 (Single mode)</td>
<td>Role: Slave only, No. of Connected Devices: 2</td>
</tr>
<tr>
<td>MK71251-02A</td>
<td>25 to 75</td>
<td>UART</td>
<td>Bluetooth® core spec. v4.1 (Single mode)</td>
<td>Role: Slave only, No. of Connected Devices: 2, Beacon Application</td>
</tr>
<tr>
<td>MK71251-02B</td>
<td>25 to 75</td>
<td>UART</td>
<td>Bluetooth® core spec. v4.1 (Single mode)</td>
<td>Role: Slave only, No. of Connected Devices: 2, Beacon Application</td>
</tr>
</tbody>
</table>

* B4D IMPORTANT: BACI (Bluetooth Application Controller Interface), LAPIS Semiconductor’s original host I/F / *2: HCI (Host Control Interface), a Bluetooth® compliant I/F

Using data loggers to record environmental conditions during transport

F eatures:
• Low power consumption
• Built-in USB device function
• Comprehensive software support

Applications:
• USB Data Loggers
• Sensors, Wireless Devices
• Data Loggers for Industrial Equipment

Highlight: SubGhz RF ICs from LAPIS Semiconductor

LAPIS SubGhz RF ICs

- SubGhz, Bluetooth®, ZigBee®
- Bluetooth® LE, IEEE802.15.4

LAPIS Bluetooth® LE ICs & Modules

- Using data loggers to record environmental conditions during transport
- Low power consumption
- Built-in USB device function
- Comprehensive software support

Applications:
- USB Data Loggers
- Sensors, Wireless Devices
- Data Loggers for Industrial Equipment

F eatures:
- Multiple power down modes
- Extensive peripherals

Applications:
- Sensor Nodes, Wireless Modules, etc.
- Battery Powered Devices Such as Electronic Shelf Labels
- Consumer Electronics, Home Appliances, Industrial Equipment

Highlight: 32bit Cortex M0+ based MCU Series

Features:
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Applications:
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F eatures:
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- Comprehensive software support

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- Data Loggers for Industrial Equipment

Highlight: Bluetooth LE Solutions

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Bluetooth® Modules

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<td>Role: Master/Slave, No. of Connected Devices: 1</td>
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* B4D IMPORTANT: BACI (Bluetooth Application Controller Interface), LAPIS Semiconductor’s original host I/F / *2: HCI (Host Control Interface), a Bluetooth® compliant I/F
WIRELESS COMMUNICATION

**Features:**
- IEEE compliance enables interconnectivity
- Support for 2 diversity ensures stable reception (ML7396x, ML7406, ML7345)
- Address filter reduces device power consumption

**Applications:**
- Telemetry
- Fire Alarms
- Smart Agriculture
- Home Security
- Industrial Remote Controls
- Asset Tracking

**Highlight:** SubGHz RF Solutions

### Specified Low Power Wireless LSIs (Data Transceiver LSIs)

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Frequency Band (MHz)</th>
<th>Transmission Rate</th>
<th>Transmission Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML7088</td>
<td>ARIB STD-T77, REC STD-30</td>
<td>436-439</td>
<td>1.2kbps, 2.4kbps, 4.8kbps (NRZ)</td>
</tr>
<tr>
<td>ML7066D</td>
<td>ARIB STD-T77, EN932-200</td>
<td>700 to 900</td>
<td>10kbps or less, 15kbps, 20kbps, 40kbps</td>
</tr>
<tr>
<td>ML7396D</td>
<td>ARIB STD-T77, REC STD-30</td>
<td>180 to 510</td>
<td>15kbps or less</td>
</tr>
<tr>
<td>ML7066</td>
<td>ARIB STD-T77, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7396A</td>
<td>ARIB STD-T77, REC STD-30</td>
<td>180 to 510</td>
<td>15kbps or less</td>
</tr>
<tr>
<td>ML7344J</td>
<td>FCC part 15.247/249</td>
<td>160 to 510</td>
<td>15kbps or less</td>
</tr>
<tr>
<td>ML7396B</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7344C</td>
<td>Q/GDW347.3</td>
<td>160 to 510</td>
<td>20kbps or less</td>
</tr>
<tr>
<td>ML7066C</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7345D</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7345C</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7406</td>
<td>EN300-220, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7345</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7406</td>
<td>EN300-220, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7345D</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7406</td>
<td>EN300-220, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>ML7345C</td>
<td>Q/GDW347.3</td>
<td>160 to 510</td>
<td>20kbps or less</td>
</tr>
<tr>
<td>ML7404</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less, 1000kbps, 2000kbps, 4000kbps</td>
</tr>
<tr>
<td>LPWA Wireless LSI (Subcarrier LSI)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ML7404D</td>
<td>ARIB STD-T77, ARIB STD-T108, REC STD-30, EN932-200, EN13757-4</td>
<td>750 to 900</td>
<td>500kbps or less (FCFS), 60k to 200kbps (QPSK)</td>
</tr>
</tbody>
</table>

**Specified Low Power Wireless LSI (Subband LSI) System LSI with Built-in MCU**

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Frequency Band (MHz)</th>
<th>Transmission Rate</th>
<th>Transmission Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML7199W</td>
<td>ARIB STD-T108</td>
<td>750 to 900</td>
<td>10kbps or less, 15kbps, 20kbps, 40kbps</td>
</tr>
</tbody>
</table>

LOW VOLTAGE POWER MANAGEMENT

Based on the long experience in power technology ROHM developed new technologies to decrease power consumption on battery driven devices:

The **Nano Energy** technology developed by ROHM is an ultra-low current consumption technology that dramatically reduces power consumption of the power supply IC. As a result, the BD70522GUL equipped with Nano Energy technology delivers a current consumption of just 180mA, the lowest in the industry.

And in response to the trade-off caused by reducing power consumption, Nano Energy technology allows the BD70522GUL to achieve simultaneously fast response, stable output voltage, and ultra-low current consumption.

**Highlight:** Low Voltage DCDC Solutions

### KEY FUNCTION

**Boost**

- **BU33UV7NX**
  - Input: 3.3V
  - Output: 5V
  - Package: UFQFN10 (5x5)
- **BD70522GUL**
  - Input: 4.0~5.5V
  - Output: 3.3V
  - Package: LQFP20 (4x4)

**Buck**

- **BU33U750**
  - Input: 3.3V
  - Output: 1.8V
  - Package: UFQFN10 (5x5)
- **BU33UV7**
  - Input: 3.3V
  - Output: 1.2V
  - Package: UFQFN10 (5x5)

**Buck-Boost**

- **BU33U750**
  - Input: 3.3V
  - Output: 1.8V
  - Package: UFQFN10 (5x5)

### Part No.

- BU33UV7NX: BU33UV7NX
- BD70522GUL: BD70522GUL
- BU33U750: BU33U750

**Feature/Characteristics**

<table>
<thead>
<tr>
<th>Function</th>
<th>Boost</th>
<th>Buck-Boost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input</strong></td>
<td>3.3V</td>
<td>3.3V</td>
</tr>
<tr>
<td><strong>Output</strong></td>
<td>5V</td>
<td>1.8V</td>
</tr>
<tr>
<td><strong>Package</strong></td>
<td>UFQFN10 (5x5)</td>
<td>UFQFN10 (5x5)</td>
</tr>
</tbody>
</table>

**Status:**
- **BU33UV7NX:** Available
- **BU33U750:** Available
- **BD70522GUL:** Available

**Note:** BOOST: BUCK: BUCK-BOOST

**Key:**

- **Input Voltage:** 3.3-5.5V
- **Output Voltage:** 1.8V
- **Maximum Output Current:** 500mA
- **Efficiency:** 91.5%
- **Package:** UFQFN10 (5x5)
- **Status:** Available
- **Date:** June 2018
Qi based Wireless Charging

ROHM provides the full range of products to support wireless charging at low and mid power according Qi standard. The line-up includes Transceiver ICs for 5W and 15W as well as Receiver ICs for 5W and 10W.

5W Solution with 5V input

- TX: BD57021 & ML610Q772
  - WPC Analog frontend
  - Two chip solution (BD57021MW + MCU)
  - WPC Compliant to Qi v1.1
  - Support WPC Low Power Coil Type LP-A11
  - Half-Bridge, Full-Bridge Inverter, 2IC Bus interface

- RX: BD57011
  - Low Power Receiver
  - WPC Compliant to Qi v1.1
  - High efficiency fully synchronous rectifier
  - Maximum Output Current 1.1A
  - Adjustable output voltage (4.3 ~ 5.3 VDC)

15W Solution with 19V input

- TX: BD57020 & ML610Q772
  - A demodulation circuit built-in
  - WPC Analog frontend
  - Two chip solution (BD57020MW + MCU)
  - WPC Compliant to Qi v1.2 with extended power profile
  - WPC Medium power coil type MP_A1, A2, A6
  - Half-Bridge, Full-Bridge Inverter, 2IC Bus interface

- RX: BD57015
  - Dual Mode Receiver
  - Compliant to Qi v1.2 and PMA SR1
  - Automatic Detection of Qi / PMA or pre-define by external pin
  - High efficiency fully synchronous rectifier
  - Adjustable output voltage: 5V to 10V
  - Maximum Output Current 1.5A

Wireless Charging – NFC based

ROHM provides a 13.56MHz NFC based Wireless Charging solution as alternative to the established Qi standard. Merits: Antenna size, Small space, Data communication, BOM cost.

<table>
<thead>
<tr>
<th>STD/Name</th>
<th>Qi 13.56MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rx Power</td>
<td>5W/15W<del>0</del>1W</td>
</tr>
<tr>
<td>Carrier</td>
<td>110-205kHz 13.56MHz</td>
</tr>
<tr>
<td>Antenna size</td>
<td>Middle Small</td>
</tr>
<tr>
<td>Antenna distance</td>
<td>5mm 5mm</td>
</tr>
<tr>
<td>Wireless Control</td>
<td>Antenna Common</td>
</tr>
<tr>
<td>Area</td>
<td>Middle Small</td>
</tr>
<tr>
<td>BOM Cost</td>
<td>Middle Small</td>
</tr>
</tbody>
</table>

ML7631 TX*: Power Transmitter
- Automatic Charging protocol operation
- Automatic Transmit output level control
- Removal detection of receiving device
- Foreign Object Detection function

ML7630 RX*: Power Receiving and NFC Tag
- 200mW LDO output
- Protocol for wireless charging is embedded
- Current, Voltage, Thermal monitoring (ADC and Comparator)
- NFC Forum Type3 TAG Function

Solutions for Battery Charging

In addition to Wireless Power Transmission ROHM also supports solutions for battery charging. The available solution depends on the number of battery cells.

- Discrete Solution using ROHM’s
  - Adjustable LDO or DCDC
  - Microcontroller
  - Boost DCDC Charger

- IC based Solution using ROHM’s
  - Buck DCDC Charger with I2C

- IC based Solution using ROHM’s
  - Buck/Boost DCDC Charger