LAPIS Semiconductor
An IoT enabling company

22nd April, 2016
Wireless Communication
Solution development unit.
Introduction
LAPIS Semiconductor, was spun off in October 2008 from Oki Electric Industry Co., Ltd. And, it became a member of the ROHM Group. In October 2011, it has changed its name to “LAPIS Semiconductor Co., Ltd.”

※At that time: OKI Semiconductor Co., Ltd.

<table>
<thead>
<tr>
<th><strong>Company Name</strong></th>
<th>LAPIS Semiconductor Co., Ltd.</th>
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<tbody>
<tr>
<td><strong>President</strong></td>
<td>Noriaki Okada</td>
</tr>
<tr>
<td><strong>Address</strong></td>
<td>2-4-8 Shinyokohama, Kouhoku-ku, Yokohama 222-8575 Japan</td>
</tr>
<tr>
<td><strong>Establishment</strong></td>
<td>October 1st, 2008</td>
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<tr>
<td><strong>Capital</strong></td>
<td>JPY 400 million</td>
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<tr>
<td><strong>Employees</strong></td>
<td>1,107 ( Consolidated )*As of Mar. 31, 2015</td>
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<tr>
<td><strong>Major Product Line</strong></td>
<td>Logic LSIs, Memory LSIs, Display driver LSIs, Foundry Service</td>
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Rohm’s Growth Engines [LSI Synergy]

Technology fusion together with LAPIS

Development and product synergy are created by fusing ROHM’s industry-leading analog technology with LAPIS Semiconductor’s digital expertise solutions.

Smart Motor Drivers

Motor drivers work efficiently in various loads by digital control of microcomputer.

Accomplish Miniaturization/High-Precision

Technology fusion together with Kionix

Development and product synergy are created by fusing ROHM’s industry-leading analog technology with Kionix’s cutting-edge MEMS solutions.

6 & 9 – Axis Sensors

• Low Noise
• High Speed Response
• Low Power Consumption
• Software Gyro Capability
• Small Footprint
• Low Cost

Applications: Wearables, Mobile, Navigation, etc.
Rohm’s Growth Engines [Sensor Devices]

Provides a rich set of Sensor Devices to center the MEMS Technology.

Sensor Technology

- MEMS
  - Accelerometers
  - Gyroscopes
- Magnetic
  - Hall Effect
- Photodiode
  - UV
  - Optical Proximity
- Non-Volatile Logic
- Piezoelectric
  - Ultrasonic
- Temperature
- Barometric Pressure
- Geomagnetic
- Ambient Light
- RGB
- IR

Analog Front End

Signal Processing

Interface

Non-Volatile Logic

ASIC

Analog Technology

Wireless Technology

- Bluetooth
- Specified Low Power
- Wireless LAN
- Zigbee
- EnOcean
- HD-PLC
- Wi-SUN
Combine Optical Devices to support a variety of applications.

### Device + Package + Emission / Control Technologies

#### LED

- **InGaAIP**
  - Red (630nm)
  - Orange (605nm)
  - Yellow (590nm)
  - Yellow - Green (564nm)
  - Green (560nm)
- **InGaAIP**
  - Infrared (850~950nm)
- **InGaN**
  - Green (527nm)
  - Blue (470nm)
- **GaAs / GaAlAs**
  - Red (635~660nm)
  - Infrared (782~842nm)
  - Infrared (850~950nm)

#### Laser Diode

- **Phosphor Technology**
  - White (0.3,0.3)
- **Photo Di**
  - Infrared (850~950nm)
- **Photo Tr.**
  - Infrared (782~842nm)
  - Red (635~660nm)

#### Mold

- CAN

#### Reflector

- High Heat Dissipation Frame

#### Ultra-Compact

- PICOLED™

#### Emission Technologies

- **Ultra-High-Efficiency LED Power Supply Module**
  - Energy Saving
  - 92% efficiency achieved (via converter system)

#### Drivers

- **Triac Dimming**
- **PWM Dimming**
- **Linear Dimming**

#### Control Technologies

- **Sensing**
  - Ambient Light Sensors
  - Motion Sensors
- **Wireless communication**
  - Wireless Communication Module

#### Applications

- **Automotive**
- **Display equipment**
- **Measurement Devices**
- **Office/Consumer Electronics**
- **Wearable Tech**
Rohm’s Growth Engines [Discrete Device]

ROHM has a proven track record and has for many years commanded a large share of the discrete products market.

- **Discrete semiconductor**
  - Transistors *¹ (MOSFETs / Bipolar / Digital)
    - Small-Signal Transistors
  - Diodes *¹ (Schottky Barrier / Fast Recovery / Rectification / High Frequency)
    - Small-Signal Diodes
  - 15%
  - 17%

- **Passives**
  - Resistors *² (chip)
    - Chip R
    - 10%

- **Optoelectronics**
  - Laser Diodes *²
    - Dual-Wavelength LD for Player
    - LD for Printer & MFP
    - 44%
    - 35%

- **Power Devices**
  - SiC-MOS, SiC-SBD, IGBT, IPM, PM
  - SiC for On-board charger *²
  - 80%

- **2014 Sales Ratio by Sector**
  - Consumer: 25%
  - Automotive: 36%
  - Communication - PC: 30%
  - Industrial: 9%

- **Market-leading compact products.**
- **Taking advantage of advanced compound semiconductors to fulfill a variety of needs.**

- **High Quality, High Automotive sales ratio**

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* Share (2013 results WW)  *¹ WSTS Survey  *² ROHM Survey
One stop IoT solution

- Low Power MCU: ML620Q504
- Gyroscope
- Pressure Sensor: BM1383GLV
- Geomagnetic Sensor: BM1422GMV
- Bluetooth Low Energy Module: KX022
- Accelerometer: MK71050-03

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Rohm Group production locations

ROHM has established centers in multiple regions to conduct timely development and analysis and provide optimum support and fast response to quality problems for customers worldwide.
Market
New approach to resolve social problems
⇒ Intelligent network + cloud computing

What can we do for wide variety of demand?

Energy
- Smart Metering
- HEMS
- Energy Save

Infra/Soil-monitor
- Disaster Prevention

Agriculture
- Food supply
- Food Safety

Logistics & Retail
- Supply chain Management

Transportation
- Convenient & Safe mobility

Factory
- Manufacturing control
  - Improvement QCD

Energy Save

Internet of Things
IoT devices

- IoT system consists of “IoT node device”, network equipment and system.
  - “IoT node device” may be combination of MCU, Connectivity, Software and Sensor

  ![Diagram](image)

  **High constraints, limited resources (power, performance)**
  - Typical example such as ESL, Logger device, RF Tag etc.
  - Combining sensing technology with wireless technology with more intelligence, things will be connected to internet.

- Quest for lowest power technology, produce world’s No.1 device suitable for various user’s application.
  - Each applications have their own key requirement and it is vary.
  - MCU+Wireless as platform, variation and differentiation by Sensor and Control
IoT example case
Bluetooth in IoT --- typical case

- **Smart Phone as network HUB**
- **cloud**

- BLE
- BLE
- BLE
- BLE
Bluetooth Beacon --- typical case

① Bluetooth Beacon generated by infra side

② User receive Beacon by their smart phone
User broadcast information by Beacon

SynapSensor

①SynapSensor unit located at infra side receive Beacon and transfer information to 920MHz radio network

920MHz band

②SynapSensor unit located at infra side receive Beacon and transfer information to 920MHz radio network

920MHz band

Connector

Information flow from terminal to Infra side

Services

cloud

Point

I
Any device such as smart watches can be connected to cloud server

II
Location X Sensing IoT infra produce various service models.

III
As Bluetooth LE uses 2.4Ghz band, 920MHz RF to avoid interference.
At Hotel or Retail stores

In case of Hotel stuff is urgently requiring support from others, by pressing a key of wrist watch to make alert to others.
Manage human resources and materials, machine condition by single system.
At School or Hospital

Location of personnel, time duration can be managed as security system.
Lapis Wireless Communication product
Wireless Products

**Bluetooth SMART / Sub-GHz**

- **LSI**: ML7105
- **Module**: MK71050
- **USB Evaluation kit**: BLE- Shield for Arduino
- **Built-in CPU**: ML7416 (Wi-SUN)
- **LSI**: ML7396 (920MHz)
- **ML7396B Evaluation kit**: Wi-SUN PHY certification

**Low Power**

- **Sub-GHz**

**Distance**

- 0.1m
- 1m
- 10m
- 100m
- 1000m

**Use environment**

- Wearable
- Home Area Network
- Office / Factory
- Metropolitan Area NW
## LSI Product Roadmap

### 2014

- **Cortex-M0**

### 2015

- **Cortex-M0+**

### 2016

- **Next Gen BLE**
- **RF + MCU**
  - **ML7416**
  - **Active Current: 3mA**
- **Hi-performance & Hi-data rate / Long-distance**

### 2017

- **LAPIS Low Power MCU**
- **RF + MCU**
  - **ML7301**
  - **Active Current: below 3mA**
- **Battery-less / BLE combo**
  - **(Battery-less)**
  - **ML620Q7xx**
  - **NFC+BLE**
  - **ML71xx**
  - **Wireless combo**
- **Ambient RF Energy Harvest**
  - **Sensitivity Controlled & High throughput**
  - **RFID ML7900**

### Bluetooth Smart (2.4GHz)

- **Low Power / MCU integrated**
  - **BLE+MCU**
    - **ML7125**
    - **Active Current: 5mA**
  - **BLE+MCU**
    - **ML7135**
    - **Active Current: 3mA**
  - **BLE+MCU / HS**
    - **ML71xx**
    - **Active Current: below 3mA**

### Sub-GHz RF (High Data Rate)

- **RF + MCU**
  - **ML7416**
  - **Active Current: 3mA**
  - **RF + MCU**
  - **ML7426**
  - **Active Current: below 3mA**

### Sub-GHz RF (Low Data Rate)

- **RF + MCU**
  - **ML7411 / ML7404**
  - **Active Current: below 3mA**

### NFC (13.56MHz)

- **R & D / NFC TEG**

### RFID (800/900MHz)

- **R & D / RFID TEG**
MK71050-03 Bluetooth SMART module

- Bluetooth SIG Core Spec v4.0
- TELEC/FCC/IC/CE certified
- Design by Insight SiP using Lapis ML7105 LSI

MK71050-03 overview

- Bluetooth SIG Core Spec v4.0
- Operating voltage 1.8 to 3.6V
- Operating temp. -20 to +70°C
- Current consumption (Typ.)
  - Tx 9mA
  - Rx 9mA
  - Sleep 0.8uA
- Radio certification
  - TELEC, FCC, IC, CE
- Bluetooth® Qualified Design (End Product QDID: 66491)
- ML7105 produced by Lapis
- 26MHz crystal oscillator
- Module size 10.7x13.6x1.78mm
SiP module enables IoT

Small, Low Power, combination of functions, Lapis/Rohm produce IoT module with SiP technologies
SiP module enables IoT

- Bluetooth and/or SubGHz
- Gyroscope & Accelerometer & Temperature
- Application CPU
- Pressure Sensor & Magnetometer & Ambient Light

- Combination of baseline function and sensor(s) cover many use cases
- Lapis will produce tailor made IoT solution optimized for each use cases
- SiP technology is one of solution to enable individual customer’s requirement
- Radio certification and qualification : ready to go solution
- Reference application code shorten customers development time
- IoT module development on going now.