LoRa® Products

Long Range, Low Power Consumption
Secure Device to Cloud Solutions
Learn, connect, collaborate, and find resources to help accelerate your development process

LoRa-developers.semtech.com
LoRa Portfolio of Products

LoRa Edge™ . . . . . . . 3
A multi-technology ultra-low power platform that leverages the LoRaWAN® protocol. This software-enabled and Cloud-based solution allows for a wide range of indoor and outdoor IoT applications.

LoRa Basics™ . . . . . . . 4
LoRa Basics consists of a suite of software tools for end node and gateways that simplifies and accelerates IoT solutions development based on LoRa modulation and LoRaWAN networks.

LoRa Core™ . . . . . . . 5
The LoRa Core portfolio consists of sub-GHz transceiver chips, gateway chips and reference designs. The portfolio represents the essential capabilities of LoRa, including long range, low power and cost effective end-to-end communication.

LoRa® 2.4GHz . . . . . . 7
LoRa 2.4GHz provides ultra long range communications in the 2.4GHz band, offering low power use and high reliability connectivity.

LoRa Cloud™ . . . . . . . 8
LoRa Cloud delivers value-added services that enable simple solutions for common tasks related to LoRaWAN networks and LoRa-based devices.

Evaluation Kits . . . . . 9
Semtech offers a wide range of evaluation kits to enable solutions development based on Semtech’s LoRa devices.

semtech.com/LoRa
LoRa Edge™
MULTI-TECHNOLOGY PLATFORM FOR IoT

Product Overview

Ultra-low power platform that integrates a long range LoRa® transceiver, multi-constellation scanner and passive Wi-Fi AP MAC address scanner targeting GNSS asset management applications.

The LoRa Edge LR1110 solution utilizes Semtech’s LoRa Cloud™ geolocation capabilities to significantly reduce power consumption by determining asset location in a Cloud-based solver.

### LoRa Edge Products

<table>
<thead>
<tr>
<th>Part number</th>
<th>LR1110</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Multi-technology indoor and outdoor asset management solution</td>
</tr>
<tr>
<td>Frequency band</td>
<td>150-960MHz</td>
</tr>
</tbody>
</table>

### Key Features

**Low Power High-Sensitivity LoRa/(G)FSK Half-Duplex RF Transceiver**

- Worldwide ISM frequency bands support from 150-960MHz
- Low Noise Figure Rx front-end for enhanced LoRa/(G) FSK sensitivity
- +22dBm High Power Transmitter Output
- +15dBm High Efficiency Transmitter Output
- Integrated PA regulator supply selector to simplify dual power +15/+22dBm with one board implementation
- Adaptive Matching Network capable of supporting multi-regions with single BOM
- Fully LoRaWAN™ standard compliant as defined by the LoRa Alliance®

### Multi-Technology RF Front-End for Geolocation Purposes

- GNSS (GPS/ BeiDou) low power scanning
- 802.11b/g/n Wi-Fi ultra-low power passive scanning
- 150-2700MHz continuous frequency synthesizer range
- High bandwidth Rx ADC (up to 24MHz DSB)
- Digital baseband processing with DSP co-processor for power consumption optimization

### Cryptographic Engine

- Hardware support for AES-128 encryption/decryption based algorithms
- Handling device parameters such as DevEUI and JoinEUI, as defined by the LoRa Alliance
- Protects confidential information such as encryption keys against unauthorized access
- Stores NwkKey and AppKey as defined in the LoRaWAN standard

### Key Benefits

- Enables companies to develop affordable asset management solutions with outstanding battery life and end-to-end robust security
- Provides a single platform solution to develop asset management applications for indoor and outdoor uses
- Enables customer to balance performance, location, accuracy and low power use which significantly reduces battery costs
- Reduces the bill of materials (BOM) by integrating GNSS, Wi-Fi and a LoRa transceiver into a single chip solution, enabling indoor and outdoor applications
- Enables customers to develop solutions that use roughly 10x less power than previous applications
- LoRa Edge is pre-provisioned with security keys using a highly secure hardware module, substantially reducing security cost
LoRa Basics™
BASIC SOFTWARE BUILDING BLOCKS

Product Overview
LoRa Basics is a set of basic software building blocks that enables solution developers to bring new innovative IoT products to market quickly, easily, reliably and cost effectively.

Key Features
LoRa Basics Modem
- Software API your firmware can use for modem configuration, wireless communication and Cloud services
- MCU hardware abstraction layer allows simple adaptation of the modem to an MCU

LoRa Basics Modem-E
- Downlink and uplink messaging
- Remote reset and re-keying
- Wi-Fi passive scanning and GNSS passive scanning
- Over the air GNSS almanac updates
- LoRa Cloud™ large file upload service, application-layer clock synchronization and reliable octet stream encoding streaming service

LoRa Basics Station
- Support for class A, B and C
- Centralized update and configuration management
- TLS and token-based authentication
- Easily portable to Linux-based gateways and embedded systems

Key Benefits
LoRa Basics Modem
- Enables a full functional LoRa 2.4GHz production stack
- Enables seamless connective with LoRa Cloud services
- Flexible open source running on MCU

LoRa Basics Modem-E
- A LoRaWAN Certified™ solution
- Accelerates time to market, reduces design complexity and lowers development cost
- Reduces amount of resources needed on the external MCU

LoRa Basics Station
- Gateway operating the LoRaWAN protocol
- Enables remote management

LoRa Basics Modem

LoRa Basics Modem-E

LoRa Basics Station

LoRa Basics

Application Code
Common API

Protocol stacks:
LoRa® 2.4GHz
Radio Planner
RAL/Directors
Semtech transceiver
(External MCU)
LoRa Basics
Modem

Protocol stacks:
LoRaWAN®
Radio Planner
RAL/Directors
LR1110 (Embedded)
LoRa Basics
Modem-E

Semtech transceiver

LoRa Basics Modem

LoRa Basics Modem-E

LoRa Basics Station

LoRa Basics Station is an implementation of a LoRa packet forwarder, and can be remotely managed by a configuration and update server to obtain configuration, system and firmware updates.
LoRa Core™
LoRa SUB-GHZ TRANSCEIVER AND GATEWAY SOLUTION

Product Overview
LoRa Core portfolio consists of sub-GHz transceiver chips, gateway chips and reference designs including SX126x series, SX127x series and LLCC68 transceiver chips, as well as the SX130x series gateway chips, legacy gateway reference designs and the LoRa® Corecell gateway reference designs. Together, they represent the essential capability of Semtech’s LoRa devices including long range, low power and cost effective end-to-end communication.

Key Features
- Long range of up to 30 miles outdoor line of sight
- Deep indoor coverage for hard to reach areas
- Bi-directional communication link with adaptive data rates
- Low power sensors with extended battery lifetime of up to 20 years
  - 100nA sleep mode
  - 4.6mA active receive mode
- LoRaWAN®, IEEE 802.15.4g and WMBus compliant
- Scalable, multi-channel, high-capacity gateways powered by SX1301, SX1302, SX1303 and SX1308
- Available for any operating environment
- Supported by the LoRa Alliance®, an open IoT Alliance for Low Power Wide Area Network (LPWAN) applications
- Large and growing online developer community for products that use LoRa
- Public, semi-private and private networks available worldwide

Key Benefits
**Long Range:** Penetrates in dense urban and deep indoor environments, connecting to sensors up to 30 miles away in rural areas

**Scalability:** Easy and quick to adapt the network capacity to business needs

**Low Power:** Designed specifically for low power consumption, extending battery lifetime up to 20 years

**High Capacity:** Supports millions of messages per base station

**Geolocation:** Enables GPS free, low power tracking applications

**Standardized:** LoRaWAN specification ensures global interoperability among applications, IoT solution providers and telecom operators

**Secure:** Embedded end-to-end AES-128 encryption of data for optimal privacy and protection

**Low Cost:** Reduces costs three ways: infrastructure investment, operating expenses and end-node sensors
## LoRa Core Transceiver ICs

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Frequency Range (MHz)</th>
<th>Link Budget (dB)</th>
<th>Rx Current (mA)</th>
<th>Max Sensitivity (dBm)</th>
<th>Tx Power (dBm)</th>
<th>LoRa Data Rate (kbps)</th>
<th>Integrated DC-DC and LDO</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX1261</td>
<td>150–960</td>
<td>163</td>
<td>4.6</td>
<td>-148</td>
<td>+15</td>
<td>0.018–62.5</td>
<td>•</td>
</tr>
<tr>
<td>SX1262</td>
<td>150–960</td>
<td>170</td>
<td>4.6</td>
<td>-148</td>
<td>+22</td>
<td>0.018–62.5</td>
<td>•</td>
</tr>
<tr>
<td>SX1268</td>
<td>410–810</td>
<td>170</td>
<td>4.6</td>
<td>-148</td>
<td>+22</td>
<td>0.018–62.5</td>
<td>•</td>
</tr>
<tr>
<td>LLCC68</td>
<td>150–960</td>
<td>151</td>
<td>4.6</td>
<td>-129</td>
<td>+22</td>
<td>1.760–62.5</td>
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<tr>
<td>SX1272</td>
<td>862–1020</td>
<td>158</td>
<td>10</td>
<td>-138</td>
<td>+20</td>
<td>0.3–40</td>
<td>•</td>
</tr>
<tr>
<td>SX1273</td>
<td>862–1020</td>
<td>150</td>
<td>10</td>
<td>-130</td>
<td>+20</td>
<td>1.7–40</td>
<td>•</td>
</tr>
<tr>
<td>SX1276</td>
<td>137–1020</td>
<td>168</td>
<td>11</td>
<td>-148</td>
<td>+20</td>
<td>0.018–40</td>
<td>•</td>
</tr>
<tr>
<td>SX1277</td>
<td>137–1020</td>
<td>158</td>
<td>11</td>
<td>-138</td>
<td>+20</td>
<td>1.7–40</td>
<td>•</td>
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<tr>
<td>SX1278</td>
<td>137–525</td>
<td>168</td>
<td>11</td>
<td>-148</td>
<td>+20</td>
<td>0.018–40</td>
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<tr>
<td>SX1279</td>
<td>137–960</td>
<td>168</td>
<td>11</td>
<td>-148</td>
<td>+20</td>
<td>0.018–40</td>
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## LoRa Core Gateway Digital Baseband ICs

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Main Front End</th>
<th>No. of Channels</th>
<th>No. of Demodulators (125KHz)</th>
<th>High Speed Demodulator (125/250/500KHz)</th>
<th>FSK Modem</th>
<th>Single Clock</th>
<th>Operating Temp. Range (°C)</th>
<th>Fine Timestamp</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX1301</td>
<td>SX1255, SX1257</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td></td>
<td>-40–85</td>
<td></td>
<td>QFN64 (9mmx9mm)</td>
</tr>
<tr>
<td>SX1302</td>
<td>SX1250, SX1255, SX1257</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>1</td>
<td>•</td>
<td>-40–85</td>
<td></td>
<td>QFN64 (7mmx7mm)</td>
</tr>
<tr>
<td>SX1303</td>
<td>SX1250, SX1255, SX1257</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>1</td>
<td>•</td>
<td>-40–85</td>
<td></td>
<td>QFN64 (7mmx7mm)</td>
</tr>
<tr>
<td>SX1308</td>
<td>SX1255, SX1257</td>
<td>8</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td></td>
<td>0–70</td>
<td></td>
<td>QFN64 (9mmx9mm)</td>
</tr>
</tbody>
</table>

## LoRa Core Gateway RF Analog Front End ICs

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Tx/Rx</th>
<th>Band (MHz)</th>
<th>Tx Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX1250</td>
<td>Tx/Rx</td>
<td>150–960</td>
<td>22</td>
</tr>
<tr>
<td>SX1255</td>
<td>Tx/Rx</td>
<td>400–510</td>
<td>-20 to +8dBm</td>
</tr>
<tr>
<td>SX1257</td>
<td>Tx/Rx</td>
<td>860–1000</td>
<td>-20 to +8dBm</td>
</tr>
<tr>
<td>SX1258</td>
<td>Tx/Rx</td>
<td>779–787</td>
<td>-20 to +8dBm</td>
</tr>
</tbody>
</table>
LoRa® 2.4GHz
LONG RANGE GLOBAL INTEROPERABILITY

Product Overview
LoRa 2.4 GHz offers ultra-long communication in the 2.4 GHz band with low power use and high reliability connectivity.

Key Features
- **Long Range Radio in the Worldwide ISM 2.4GHz Band**
  - High sensitivity to -132dBm
  - 12.5dBm output power with high efficiency PA
  - 144.5dB maximum link budget (up to 3km LoS)

- **Open Source Proprietary Protocol Stack**
  - Pre-integrated with Semtech’s LoRa Cloud™ services
  - RTOS and MCU agnostic

- **Low System Cost**
  - Minimal external BOM/matching
  - Package low foot print, 24-pin 4x4

- **Multi Radio**
  - LoRa – 476bps up to 250kbps
  - FLRC – 260kbps up to 1.3Mbps
  - (G)FSK/MSK – up to 2Mbps
  - BLE PHY layer compatibility

- **Ranging Engine for Proximity Detection**
  - Time-of-flight functionality
  - +/- 3m accuracy

- **Low Power**
  - <5mA Rx current consumption
  - 24mA Tx @ +12.5dBm
  - 215nA sleep mode

Key Benefits
- LoRa capabilities (i.e., long range, low power, robustness to interferers) at 2.4GHz address IoT markets where single SKU, worldwide interoperability, high data rate and no duty cycle limitations are required
- Indoor/outdoor connectivity and low power proximity detection with low bill of materials
- Fully documented pre-certification for FCC and ETSI gateway reference design reduces development time
LoRa Cloud™
ADDED VALUE SERVICES

Product Overview
LoRa Cloud provides value-added services that enable simple solutions for common tasks related to LoRaWAN® networks and devices that use LoRa®.

LoRa Cloud Geolocation for Gateways or Transceiver-based Devices
LoRa Cloud Geolocation is a simple cloud API that can be easily integrated with a LoRaWAN network or application server to enable location estimation via any device that uses LoRa.

Key Features
- Calculate location device based on metadata such as received signal strength, signal-to-noise ratio and time of arrival
- Devices in transceiver mode, such as LoRa Edge™ LR1110 can calculate location based on GNSS or Wi-Fi data

LoRa Cloud Device and Application Services With Geolocation for Modem-based Devices
- Device telemetry
- Device and application configuration
- Clock synchronization
- Advanced data transport services with configurable robustness against packet loss and transparent data fragmentation
- Location solver for LoRa Edge LR1110 GNSS and Wi-Fi while using LoRa Basics™ Modem or LoRa Basics Modem-E

LoRa Cloud Device Join
- The standard LoRaWAN join server backend interface connects with compliant LoRaWAN network servers to provide fully secure end device onboarding and network joining
- The secret security keys are embedded in the device using a highly secure module based provisioning system
- The join server is connected to a hardware secure module, which processes Device Join requests without ever exposing device keys
- LoRa Cloud Device & Application Services enables join server device migration via key extraction and end device re-keying

Key Benefits
- Simplified managed endpoint solutions development via easy to use Cloud APIs
- Geolocation services tightly coupled with LR1110 reduce power consumption by 10x compared to conventional GPS technologies
- LoRa Cloud Device Join service enhances security and avoids network server lock-in
# RF Evaluation Kits

**APPLICATION-SPECIFIC**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Evaluation Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LLCC68</strong></td>
<td>LLCC68 @868mhz Mbed Shield; +15dBm</td>
<td>LLCC68MB2BAS</td>
</tr>
<tr>
<td></td>
<td>LLCC68 @915mhz Mbed Shield; +22dBm</td>
<td>LLCC68MB2CAS</td>
</tr>
<tr>
<td></td>
<td>LLCC68 @490mhz Mbed Shield; +20dBm</td>
<td>LLCC68MB2GAS</td>
</tr>
<tr>
<td><strong>LR1110</strong></td>
<td>LR1110 Development Kit @915Mhz for North America</td>
<td>LR1110DVK1TCKS</td>
</tr>
<tr>
<td></td>
<td>LR1110 Development Kit @868Mhz for Europe</td>
<td>LR1110DVK1TBKS</td>
</tr>
<tr>
<td></td>
<td>LR1110 Development Kit @490Mhz for China/Asia</td>
<td>LR1110DVK1TGKS</td>
</tr>
<tr>
<td><strong>SX1261</strong></td>
<td>Development Kit, SX1261, 868MHz for Europe</td>
<td>SX1261DVK1BAS</td>
</tr>
<tr>
<td></td>
<td>Development Kit, SX1261, 923MHz for Asia</td>
<td>SX1261DVK1CAS</td>
</tr>
<tr>
<td></td>
<td>Development Kit, SX1261, 923MHz for Japan TELEC</td>
<td>SX1261DVK1CASTELEC</td>
</tr>
<tr>
<td></td>
<td>Mbed Shield, SX1261, 868MHz for Europe</td>
<td>SX1261MB2BAS</td>
</tr>
<tr>
<td><strong>SX1262</strong></td>
<td>Development Kit, SX1262, 915MHz for North America</td>
<td>SX1262DVK1CAS</td>
</tr>
<tr>
<td></td>
<td>Development Kit, SX1262, 866MHz for India</td>
<td>SX1262DVK1DAS</td>
</tr>
<tr>
<td></td>
<td>Development Kit, SX1262, 915MHz for Australia and North America</td>
<td>SX1262DVK1PAS</td>
</tr>
<tr>
<td></td>
<td>Development Kit, SX1262, 923MHz for Korea</td>
<td>SX1262DVK1CBS</td>
</tr>
<tr>
<td></td>
<td>Mbed Shield, SX1262, 915MHz for North America</td>
<td>SX1262MB2CAS</td>
</tr>
<tr>
<td><strong>SX1268</strong></td>
<td>Development Kit, SX1268, 490MHz for China and Asia</td>
<td>SX1268DVK1GAS</td>
</tr>
<tr>
<td></td>
<td>Development Kit, SX1268, 780MHz for China and Asia</td>
<td>SX1268DVK1NAS</td>
</tr>
<tr>
<td><strong>SX1272</strong></td>
<td>Development Kit, SX1272, 868MHz</td>
<td>SX1272DVK1BAS (868MHz)</td>
</tr>
<tr>
<td></td>
<td>Development Kit, SX1272, 915MHz</td>
<td>SX1272DVK1CAS (915MHz)</td>
</tr>
<tr>
<td></td>
<td>Mbed Shield, SX1272, 868 and 915MHz</td>
<td>SX1272MB2DAS</td>
</tr>
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</table>
## Tx/Rx Kits With LoRa® (Continued)

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Evaluation Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX1276</td>
<td>Development Kit, SX1276, 169MHz (LF) or 868MHz (HF)</td>
<td>SX1276DVK1IAS (169MHz and 868MHz)</td>
</tr>
<tr>
<td>SX1276</td>
<td>Development Kit, SX1276, 433MHz (LF) or 868MHz (HF)</td>
<td>SX1276DVK1IAS (433MHz and 868MHz)</td>
</tr>
<tr>
<td>SX1276</td>
<td>Development Kit, SX1276, 470MHz (LF) or 915MHz (HF)</td>
<td>SX1276DVK1KAS (490MHz and 915MHz)</td>
</tr>
<tr>
<td>SX1278</td>
<td>Mbed Shield, SX1276, 433MHz (LF) or 915MHz (HF)</td>
<td>SX1276MB1LAS</td>
</tr>
<tr>
<td>SX1278</td>
<td>Mbed Shield, SX1276, 433MHz (LF) or 868MHz (HF)</td>
<td>SX1276MB1MAS</td>
</tr>
<tr>
<td>SX1278</td>
<td>Low Power RF Transceiver 138–510MHz with LoRa Modem</td>
<td>Use SX1276 kit (SX1276 is a superset)</td>
</tr>
<tr>
<td>SX1280</td>
<td>Development Kit, SX1280, 2.4GHz</td>
<td>SX1280DVK1ZHP</td>
</tr>
<tr>
<td>SX1280</td>
<td>SX1280 Development Kit for LoRa Basics™ Modem 2.4GHz</td>
<td>SX1280ED1ZHP</td>
</tr>
<tr>
<td>SX1281</td>
<td>Development Kit, SX1280, 2.4GHz</td>
<td>SX1280DVK1ZHP</td>
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</table>

## Gateway Kits With LoRa

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Evaluation Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>SX1280</td>
<td>Reference Design for 2.4GHz Gateway Based on SX1280</td>
<td>SX1280ZXXXXGW1</td>
</tr>
<tr>
<td>SX1302</td>
<td>LoRa Corecell Reference Design for Gateway Applications Based on SX1302 and SX1250</td>
<td>SX1302CxxxGW1</td>
</tr>
<tr>
<td>SX1302</td>
<td>LoRa Corecell Reference Design for Full Duplex Gateway Applications Based on SX1302 and SX1255</td>
<td>SX1302CFDXXGW</td>
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<tr>
<td>SX1303</td>
<td>LoRa Corecell Gateway Reference Design for Listen Before Talk (LBT) and Spectral Scan Based on SX1302 and SX1250</td>
<td>SX1302CSSXXXGW1</td>
</tr>
<tr>
<td>SX1303</td>
<td>LoRa Corecell Gateway Reference Design for Fine Timestamp Based on SX1303</td>
<td>SX1303CTXXGW1</td>
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<tr>
<td>SX1308</td>
<td>PicoCell Gateway, SX1308, 490 MHz</td>
<td>SX1308P490GW</td>
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<tr>
<td>SX1308</td>
<td>PicoCell Gateway, SX1308, 868 MHz</td>
<td>SX1308P868GW</td>
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<td>SX1308</td>
<td>PicoCell Gateway, SX1308, 915 MHz</td>
<td>SX1308P915GW</td>
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