Waspmote

General data:

Microcontroller: ATmega1281
Frequency: 8MHz
SRAM: 8KB
EEPROM: 4KB
FLASH: 128KB
SD Card: 2GB
Weight: 20gr
Dimensions: 73.5 x 51 x 13 mm
Temperature Range: [-20ºC, +65ºC]
Clock: RTC (32KHz)

Consumption:

ON: 9mA
Sleep: 62μA
Deep Sleep: 62μA
Hibernate: 0.7μA

Operation without recharging: 1 year *

* Time obtained using the Hibernate mode as the energy saving mode

Inputs/Outputs:

7 Analog (I), 8 Digital (I/O), 1 PWM, 2 UART, 1 I2C, 1USB

Electrical data:

Battery voltage: 3.3 V - 4.2V
USB charging: 5 V - 100mA
Solar panel charging: 6 - 12 V - 280mA
Auxiliary battery voltage: 3V

Built-in sensors on the board:

Temperature (+/-): -40ºC, +85ºC. Accuracy: 0.25ºC
Accelerometer: ±2g (1024 LSb/g) / ±6g (340LSb/g) 40Hz/160Hz/640Hz/2560Hz
802.15.4/ZigBee

<table>
<thead>
<tr>
<th>Model</th>
<th>Protocol</th>
<th>Frequency</th>
<th>txPower</th>
<th>Sensitivity</th>
<th>Range *</th>
</tr>
</thead>
<tbody>
<tr>
<td>XBee-802.15.4</td>
<td>802.15.4</td>
<td>2.4GHz</td>
<td>1mW</td>
<td>-92dB</td>
<td>500m</td>
</tr>
<tr>
<td>XBee-802.15.4-Pro</td>
<td>802.15.4</td>
<td>2.4GHz</td>
<td>100mW</td>
<td>-100dBm</td>
<td>7000m</td>
</tr>
<tr>
<td>XBee-ZB</td>
<td>ZigBee-Pro</td>
<td>2.4GHz</td>
<td>2mW</td>
<td>-96dBm</td>
<td>500m</td>
</tr>
<tr>
<td>XBee-ZB-Pro</td>
<td>ZigBee-Pro</td>
<td>2.4GHz</td>
<td>50mW</td>
<td>-102dBm</td>
<td>7000m</td>
</tr>
<tr>
<td>XBee-868</td>
<td>RF</td>
<td>868MHz</td>
<td>315mW</td>
<td>-112dBm</td>
<td>12km</td>
</tr>
<tr>
<td>XBee-900</td>
<td>RF</td>
<td>900MHz</td>
<td>50mW</td>
<td>-100dBm</td>
<td>10km</td>
</tr>
<tr>
<td>XBee-XSC</td>
<td>RF</td>
<td>900MHz</td>
<td>100mW</td>
<td>-106dBm</td>
<td>12km</td>
</tr>
</tbody>
</table>

* Line of sight and 5dBi dipole antenna

Antennas: 2.4GHz: 2dBi / 5dBi  
868/900MHz: 0dBi / 4.5dBi

Connector: RPSMA

Encryption: AES 128b

Control Signal: RSSI

Standards: XBee-802.15.4 - 802.15.4 Compliant / XBee-ZB - ZigBee-Pro v2007 Compliant

Topologies: star, tree, mesh

Figure 3: XBee

Figure 4: Star

Figure 5: Tree

Figure 6: Mesh
Over the Air Programming (OTA)

Benefits:

- Enables the upgrade or change of firmware versions without physical access
- Enables to recover to any sensor node which gets stuck
- Discover nodes in the area just sending a broadcast discovery query
- Upload new firmware in just a couple of minutes
- No interferences: OTA is performed using a change of channel between the programmer and the desired node so no interferences are generated to the rest of the nodes

Topologies:

- Direct access: when the nodes are accessed in just one hop (no forwarding of the packets is needed).
- Multihop: when the nodes are accessed in two or more hops. In this mode some nodes have to forward the packets sent by the Gateway in order to reach the destination.

Modes:

- Unicast: Reprogram an specific node
- Multicast: Reprogram several nodes at the same time sending the program just once
- Broadcast: Reprogram the entire network sending the program just once
**Wifi**

**Protocols:** 802.11b/g - 2.4GHz  
**TX Power:** 0dBm - 12dBm (variable by software)  
**RX Sensitivity:** -83dBm  
**Antenna connector:** RPSMA  
**Antenna:** 2dBi/5dBi antenna options  
**Security:** WEP, WPA, WPA2  
**Topologies:** AP and Adhoc  
**802.11 roaming capabilities**

**Actions:**  
- TCP/IP - UDP/IP socket connections  
- HTTP and HTTPS (secure) web connections  
- FTP and FTPS (secure) file transfers  
- Direct connections with iPhone and Android  
- Connects with any standard Wifi router  
- DHCP for automatic IP assignation  
- DNS resolution enabled

**Bluetooth**

**Bluetooth Chip:** eUnistone 31308/2  
**Version:** Bluetooth 2.0 + EDR (Configurable BT 1.2)  
**TX Power:** 2.5dBm  
**RX Sensitivity:** -86dBm  
**Antenna:** 2dBi / 5dBi  
**Antenna Connector:** RPSMA  
**Outdoor Range:** 250m  
**Indoor Range:** 30m

**Actions:**  
- Scanning of new devices  
- Security - PIN mode  
- Adaptive Frequency Hoping (AFH)  
- Serial Port Profile (SPP)  
- Trusted nodes management
**GSM/GPRS**

**Model:** SIM900 (SIMCom)

**Quadband:** 850MHz/900MHz/1800MHz/1900MHz

**TX Power:** 2W(Class 4) 850MHz/900MHz, 1W(Class 1) 1800MHz/1900MHz

**Sensitivity:** -109dBm

**Antenna connector:** UFL

**External Antenna:** 0dBi

**Consumption in power down mode:** 30µA

**Actions:**

- Making/Receiving calls
- Making ‘x’ tone missed calls
- Sending/Receiving SMS
- Single connection and multiple connections TCP/IP and UDP/IP clients
- TCP/IP server
- HTTP Service
- FTP Service (downloading and uploading files)

---

**Bluetooth module for device discovery**

**Protocol:** Bluetooth 2.1 + EDR. Class 2

**TX Power:** 3dBm

**Antenna:** 2dBi

**Max Scan:** Up to 250 unique devices in each inquiry

**Power levels:** 7 [-27dBm, +3dBm]

**Application**

- Vehicular and pedestrian traffic monitoring

**Features:**

- Received Strength Signal Indicator (RSSI) for each scanned device
- Scan devices with maximum inquiry time
- Scan devices with maximum number of nodes
- Scan devices looking for a certain user by MAC address
- Class of Device (CoD) for each scanned device
RFID/NFC

13.56MHz

- **Compatibility**: Reader/writer mode supporting ISO 14443A / MIFARE / FeliCaTM / NFCIP-1
- **Distance**: 5cm
- **Max capacity**: 4KB
- **Tags**: cards, keyrings, stickers

Applications

- Located based services (LBS)
- Logistics (assets tracking, supply chain)
- Access management
- Electronic prepaid metering (vending machines, public transport)
- Smartphone interaction (NFCIP-1 protocol)

125KHz

- **Compatibility**: Reader/writer mode supporting ISO cards - T5557 / EM4102
- **Distance**: 5cm
- **Max capacity**: 20B
- **Tags available**: cards, keyrings

Applications

- Located based services (LBS)
- Logistics (assets tracking, supply chain)
- Product management
- Animal farming identification
Expansion Radio Board

The Expansion Radio Board allows to connect two radios at the same time. This means a lot of different combinations are now possible using any of the six radios available for Wasp mote: 802.15.4, ZigBee, Bluetooth, RFID, Wifi, 3G/GPRS, 868 and 900.

Some of the possible combinations are:

- ZigBee - Bluetooth
- ZigBee - RFID
- ZigBee - Wifi
- ZigBee - 3G/GPRS
- Bluetooth - RFID
- RFID - 3G/GPRS
- etc.

Remark: the 3G/GPRS module does not need the Expansion Board to be connected to Wasp mote. It can be plugged directly in the 3G/GPRS socket.

Applications:

- Multifrequency Sensor Networks: (2.4GHz - 868/900MHz)
- Bluetooth - ZigBee hybrid networks
- NFC (RFID) applications with 3G/GPRS
- ZigBee - Wifi hybrid networks

GPS

Model: A1084 (Vincotech)
Movement sensitivity: -159dBm
Acquisition sensitivity: -142dBm
Hot Start Time: <1s
Warm Start Time: <32s
Cold Start Time: <35s
Antenna connector: UFL
External antenna: 26dBi

Available information: latitude, longitude, height, speed, direction, date/time and ephemerids management.

Programmable interruptions:

- Asynchronous
  - Sensors (programmable threshold)
  - Low Battery (programmable threshold)
  - Accelerometer: Free-fall, impact (programmable threshold)
  - Arrival of SMS, calls and data

- Synchronous:
  - Watchdog: programmable alarms: from 32ms to 8s
  - RTC: programmable alarms: from 1s to days
Sensor Boards

<table>
<thead>
<tr>
<th>GASES</th>
<th>APPLICATIONS</th>
<th>SENSORS</th>
</tr>
</thead>
</table>
| • City pollution  
  CO, CO₂, NO₂, O₃  | • Carbon Monoxide – CO  
  • Carbon Dioxide – CO₂  | |
| • Emissions from farms and hatcheries  
  CH₄, H₂S, NH₃  | • Oxygen – O₂  
  • Methane – CH₄  | |
| • Control of chemical and industrial processes  
  C₄H₁₀, H₂, VOC  | • Hydrogen – H₂  
  • Ammonia – NH₃  | |
| • Forest fires  
  CO, CO₂  | • Isobutane – C₄H₁₀  
  • Ethanol – CH₃CH₂OH  | |

- Carbon Monoxide – CO
- Carbon Dioxide – CO₂
- Oxygen – O₂
- Methane – CH₄
- Hydrogen – H₂
- Ammonia – NH₃
- Isobutane – C₄H₁₀
- Ethanol – CH₃CH₂OH

Figure 18: Gases Board

<table>
<thead>
<tr>
<th>EVENTS</th>
<th>APPLICATIONS</th>
<th>SENSORS</th>
</tr>
</thead>
</table>
| • Security  
  Vibration, hall effect (doors and windows), person detection PIR  | • Pressure/Weight  
  • Bend  | |
| • Emergencies  
  Presence detection and water level sensors, temperature  | • Vibration  
  • Impact  | |
| • Control of goods in logistics  
  Vibration and impact sensors  | • Hall Effect  
  • Tilt  | |
| • Temperature (+/-)  
  • Liquid Presence  | • Liquid Level  
  • Luminosity  | |
| • Liquid Level  
  • Liquid Level  | • Presence (PIR)  
  • Stretch  | |

- Pressure/Weight
- Bend
- Vibration
- Impact
- Hall Effect
- Tilt
- Temperature (+/-)
- Liquid Presence
- Liquid Level
- Luminosity
- Presence (PIR)
- Stretch

Figure 19: Events Board
### SMART CITIES

<table>
<thead>
<tr>
<th>APPLICATIONS</th>
<th>SENSORS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noise maps</strong>&lt;br&gt;Monitor in real time the acoustic levels in the streets of a city</td>
<td>• Microphone (dBSPLA)</td>
</tr>
<tr>
<td><strong>Structural health monitoring</strong>&lt;br&gt;Crack detection and propagation</td>
<td>• Crack detection gauge&lt;br&gt;• Crack propagation gauge&lt;br&gt;• Linear displacement&lt;br&gt;• Dust - PM-10&lt;br&gt;• Ultrasound (distance measurement)</td>
</tr>
<tr>
<td><strong>Air quality</strong>&lt;br&gt;Detect the level of particulates and dust in the air</td>
<td>• Temperature&lt;br&gt;• Humidity&lt;br&gt;• Luminosity</td>
</tr>
<tr>
<td><strong>Waste management</strong>&lt;br&gt;Measure the garbage levels in bins to optimize the trash collection routes</td>
<td></td>
</tr>
</tbody>
</table>
### Radiation Applications

- Monitor the radiation levels wirelessly without comprising the life of the security forces.
- Create prevention and control radiation networks in the surroundings of a nuclear plant.
- Measure the amount of Beta and Gamma radiation in specific areas autonomously.

**Figure 23: Radiation Board**

| Geiger tube $[\beta, \gamma]$ (Beta and Gamma) |

### Smart Metering Applications

- Energy measurement
- Water consumption
- Pipe leakage detection
- Liquid storage management
- Tanks and silos level control
- Supplies control in manufacturing
- Industrial Automation
- Agricultural Irrigation

**Figure 24: Smart Metering Board**

| Current |
| Water flow |
| Liquid level |
| Load cell |
| Ultrasound |
| Distance Foil |
| Temperature |
| Humidity |
| Luminosity |

### Prototyping Sensor Applications

- Prepared for the **integration of any kind of sensor**.

**Figure 25: Prototyping Sensor Board**

| Pad Area |
| Integrated Circuit Area |
| Analog-to-Digital Converter (16b) |
Power supplies

- 1150mA/2300mA/6600mA Li-Ion rechargeable // 13000mAH **non-rechargeable**
- Solar Panel: rigid (7V – 500mA) and flexible (7.2V – 100mA)
- USB (220V-USB, car lighter USB)

USB-PC interface

Model: Waspmote Gateway *
Communication: 802.15.4/ZigBee - USB PC
Programmable buttons and leds
* Included in the developers Kit

Compiler:

- IDE-Waspmote (open source)
- Language: C++
- Versions Windows, Linux and Mac-OS

*Figure 26: Waspmote Gateway*
Wasmote Plug & Sense! - Encapsulated Line

The new Wasmote Plug & Sense! line allows you to easily deploy wireless sensor networks in an easy and scalable way ensuring minimum maintenance costs. The new platform consists of a robust waterproof enclosure with specific external sockets to connect the sensors, the solar panel, the antenna and even the USB cable in order to reprogram the node. It has been specially designed to be scalable, easy to deploy and maintain.

Note: For a complete reference guide download the "Wasmote Plug & Sense! Technical Guide" in the Support section of the Libelium website.

Features

- Robust waterproof IP65 enclosure
- Add or change a sensor probe in seconds
- Solar powered with internal and external panel options
- Radios available: Zigbee, 802.15.4, Wifi, 868MHz, 900MHz and 3G/GPRS
- Over the air programming (OTAP) of multiple nodes at once
- Special holders and brackets ready for installation in street lights and building fronts
- Graphical and intuitive programming interface

Sensor Probes

Sensor probes can be easily attached by just screwing them into the bottom sockets. This allows you to add new sensing capabilities to existing networks just in minutes. In the same way, sensor probes may be easily replaced in order to ensure the lowest maintenance cost of the sensor network.

Figure 27: Connecting a sensor probe to Wasmote Plug & Sense!
Solar Powered

Battery can be recharged using the internal or external solar panel options. The external solar panel is mounted on a 45º holder which ensures the maximum performance of each outdoor installation.

![External solar panel](image1)

**Figure 28: Waspmote Plug & Sense! powered by an external solar panel**

For the internal option, the solar panel is embedded on the front of the enclosure, perfect for use where space is a major challenge.

![Internal solar panel](image2)

**Figure 29: Internal solar panel**
Programming the Nodes

Waspmote Plug & Sense! can be reprogrammed in two ways:

The basic programming is done from the USB port. Just connect the USB to the specific external socket and then to the computer to upload the new firmware.
Over the Air Programming is also possible once the node has been installed. With this technique you can reprogram wirelessly one or more Waspmote sensor nodes at the same time by using a laptop and the Waspmote Gateway.

Radio Interfaces

<table>
<thead>
<tr>
<th>Model</th>
<th>Protocol</th>
<th>Frequency</th>
<th>txPower</th>
<th>Sensitivity</th>
<th>Range *</th>
</tr>
</thead>
<tbody>
<tr>
<td>XBee-802.15.4</td>
<td>802.15.4</td>
<td>2.4GHz</td>
<td>1mW</td>
<td>-92dB</td>
<td>500m</td>
</tr>
<tr>
<td>XBee-802.15.4-Pro</td>
<td>802.15.4</td>
<td>2.4GHz</td>
<td>100mW</td>
<td>-100dBm</td>
<td>7000m</td>
</tr>
<tr>
<td>XBee-ZB</td>
<td>ZigBee-Pro</td>
<td>2.4GHz</td>
<td>2mW</td>
<td>-96dBm</td>
<td>500m</td>
</tr>
<tr>
<td>XBee-ZB-Pro</td>
<td>ZigBee-Pro</td>
<td>2.4GHz</td>
<td>50mW</td>
<td>-102dBm</td>
<td>7000m</td>
</tr>
<tr>
<td>XBee-868</td>
<td>RF</td>
<td>868MHz</td>
<td>315mW</td>
<td>-112dBm</td>
<td>12km</td>
</tr>
<tr>
<td>XBee-900</td>
<td>RF</td>
<td>900MHz</td>
<td>50mW</td>
<td>-100dBm</td>
<td>10Km</td>
</tr>
<tr>
<td>XBee-XSC</td>
<td>RF</td>
<td>900MHz</td>
<td>100mW</td>
<td>-106dBm</td>
<td>12Km</td>
</tr>
</tbody>
</table>

* Line of sight and Fresnel zone with 5dBi dipole antenna

Program in minutes

In order to program the nodes an intuitive graphic interface has been developed. Developers just need to fill a web form in order to obtain the complete source code for the sensor nodes. This means the complete program for an specific application can be generated just in minutes. Check the Code Generator to see how easy it is at:

http://www.libelium.com/development/waspmote/code_generator
Data to the Cloud

The Sensor data gathered by the Waspmote Plug & Sense! nodes is sent to the Cloud by **Meshlium**, the Gateway router specially designed to connect Waspmote sensor networks to the Internet via Ethernet, Wifi and 3G interfaces.

![Meshlium](image-url)
Meshlium Storage Options

- Local File System
- Local Data Base
- External Data Base

Meshlium Connection Options

- ZigBee -> Ethernet
- ZigBee -> Wifi
- ZigBee -> 3G/GPRS
Models

There are some defined configurations of Waspmote Plug & Sense! depending on which sensors are going to be used. Waspmote Plug & Sense! configurations allows connecting up to six sensor probes at the same time.

Each model takes a different conditioning circuit to enable the sensor integration. For this reason each model allows to connect just its specific sensors.

This section describes each model configuration in detail, showing the sensors which can be used in each case and how to connect them to Waspmote. In many cases, the sensor sockets accept the connection of more than one sensor probe. See the compatibility table for each model configuration to choose the best probe combination for the application.

It is very important to remark that each socket is designed only for one specific sensor, so they are not interchangeable. Always be sure you connected probes in the right socket, otherwise they can be damaged.

![Identification of sensor sockets](image-url)
Smart Environment

Smart Environment model is designed to monitor environmental parameters such as temperature, humidity, atmospheric pressure and some types of gases. The main applications for this Wasmote Plug & Sense! configuration are city pollution measurement, emissions from farms and hatcheries, control of chemical and industrial processes, forest fires, etc. Go to the application section in the Libelium website for a complete list of services.

![Smart Environment Waspmote Plug & Sense! model](image)

*Figure 36: Smart Environment Waspmote Plug & Sense! model*
Sensor sockets are configured as shown in the figure below.

<table>
<thead>
<tr>
<th>Sensor Socket</th>
<th>Parameter</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Temperature</td>
<td>9203</td>
</tr>
<tr>
<td></td>
<td>Carbon monoxide - CO</td>
<td>9229</td>
</tr>
<tr>
<td></td>
<td>Methane - CH₄</td>
<td>9232</td>
</tr>
<tr>
<td></td>
<td>Ammonia – NH₃</td>
<td>9233</td>
</tr>
<tr>
<td></td>
<td>Liquid Petroleum Gases: H₂, CH₄, ethanol, isobutene.</td>
<td>9234</td>
</tr>
<tr>
<td></td>
<td>Air pollutants 1: C₄H₁₀, CH₃CH₂OH, H₂, CO, CH₄</td>
<td>9235</td>
</tr>
<tr>
<td></td>
<td>Air pollutants 2: C₆H₅CH₃, H₂S, CH₃CH₂OH, NH₃, H₂</td>
<td>9236</td>
</tr>
<tr>
<td></td>
<td>Alcohol derivates: CH₃CH₂OH, H₂, C₄H₁₀, CO, CH₄</td>
<td>9237</td>
</tr>
<tr>
<td>B</td>
<td>Humidity</td>
<td>9204</td>
</tr>
<tr>
<td></td>
<td>Atmospheric pressure</td>
<td>9250</td>
</tr>
<tr>
<td>C</td>
<td>Carbon dioxide - CO₂</td>
<td>9230</td>
</tr>
<tr>
<td>D</td>
<td>Nitrogen dioxide - NO₂</td>
<td>9238</td>
</tr>
<tr>
<td>E</td>
<td>Ozone - O₃</td>
<td>9258</td>
</tr>
<tr>
<td></td>
<td>Hydrocarbons - VOC</td>
<td>9201</td>
</tr>
<tr>
<td></td>
<td>Oxygen - O₂</td>
<td>9231</td>
</tr>
<tr>
<td>F</td>
<td>Carbon monoxide - CO</td>
<td>9229</td>
</tr>
<tr>
<td></td>
<td>Methane - CH₄</td>
<td>9232</td>
</tr>
<tr>
<td></td>
<td>Ammonia – NH₃</td>
<td>9233</td>
</tr>
<tr>
<td></td>
<td>Liquid Petroleum Gases: H₂, CH₄, ethanol, isobutene.</td>
<td>9234</td>
</tr>
<tr>
<td></td>
<td>Air pollutants 1: C₄H₁₀, CH₃CH₂OH, H₂, CO, CH₄</td>
<td>9235</td>
</tr>
<tr>
<td></td>
<td>Air pollutants 2: C₆H₅CH₃, H₂S, CH₃CH₂OH, NH₃, H₂</td>
<td>9236</td>
</tr>
<tr>
<td></td>
<td>Alcohol derivates: CH₃CH₂OH, H₂, C₄H₁₀, CO, CH₄</td>
<td>9237</td>
</tr>
</tbody>
</table>

**Figure 37: Sensor sockets configuration for Smart Environment model**

**Note:** For more technical information about each sensor probe go to the Support section in Libelium website.
Smart Security

The main applications for this Waspmote Plug & Sense! configuration are perimeter access control, liquid presence detection and doors and windows openings.

Figure 38: Smart Security Waspmote Plug & Sense! model
Note: The probes attached in this photo could not match the final location. See next table for the correct configuration.

<table>
<thead>
<tr>
<th>Sensor Socket</th>
<th>Sensor probes allowed for each sensor socket</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Temperature + Humidity (Sensirion)</td>
<td>9247</td>
</tr>
<tr>
<td>B</td>
<td>Liquid flow</td>
<td>9296, 9297, 9298</td>
</tr>
<tr>
<td>C</td>
<td>Presence - PIR</td>
<td>9212</td>
</tr>
<tr>
<td>D</td>
<td>Luminosity</td>
<td>9205</td>
</tr>
<tr>
<td></td>
<td>Liquid level</td>
<td>9239, 9240, 9242</td>
</tr>
<tr>
<td></td>
<td>Liquid presence</td>
<td>9243</td>
</tr>
<tr>
<td></td>
<td>Hall effect</td>
<td>9207</td>
</tr>
<tr>
<td>E</td>
<td>Luminosity</td>
<td>9205</td>
</tr>
<tr>
<td></td>
<td>Liquid level</td>
<td>9239, 9240, 9242</td>
</tr>
<tr>
<td></td>
<td>Liquid presence</td>
<td>9243</td>
</tr>
<tr>
<td></td>
<td>Hall effect</td>
<td>9207</td>
</tr>
<tr>
<td>F</td>
<td>Luminosity</td>
<td>9205</td>
</tr>
<tr>
<td></td>
<td>Liquid level</td>
<td>9239, 9240, 9242</td>
</tr>
<tr>
<td></td>
<td>Liquid presence</td>
<td>9243</td>
</tr>
<tr>
<td></td>
<td>Hall effect</td>
<td>9207</td>
</tr>
</tbody>
</table>

Figure 39: Sensor sockets configuration for Smart Security model

Note: For more technical information about each sensor probe go to the Support section in Libelium website.
Smart Metering

The main applications for this Waspmote Plug & Sense! model are energy measurement, water consumption, pipe leakage detection, liquid storage management, tanks and silos level control, supplies control in manufacturing, industrial automation, agricultural irrigation, etc. Go to the application section in the Libelium website for a complete list of services.

Figure 40: Smart Metering Waspmote Plug & Sense! model
Sensor sockets are configured as shown in the figure below.

<table>
<thead>
<tr>
<th>Sensor Socket</th>
<th>Parameter</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Temperature</td>
<td>9203</td>
</tr>
<tr>
<td></td>
<td>Soil temperature</td>
<td>86949*</td>
</tr>
<tr>
<td>B</td>
<td>Humidity</td>
<td>9204</td>
</tr>
<tr>
<td>C</td>
<td>Ultrasound (distance measurement)</td>
<td>9246</td>
</tr>
<tr>
<td></td>
<td>Liquid flow</td>
<td>9296, 9297, 9298</td>
</tr>
<tr>
<td>D</td>
<td>Current sensor</td>
<td>9266</td>
</tr>
<tr>
<td>E</td>
<td>Ultrasound (distance measurement)</td>
<td>9246</td>
</tr>
<tr>
<td></td>
<td>Liquid flow</td>
<td>9296, 9297, 9298</td>
</tr>
<tr>
<td>F</td>
<td>Luminosity</td>
<td>9205</td>
</tr>
</tbody>
</table>

* Ask Libelium **Sales Department** for more information.

**Note:** For more technical information about each sensor probe go to the **Support section** in Libelium website.
Smart Cities

The main applications for this Waspmote Plug & Sense! model are noise maps (monitor in real time the acoustic levels in the streets of a city), air quality, waste management, structural health, smart lighting, etc. Refer to Libelium website for more information.

Figure 42: Smart Cities Waspmote Plug & Sense! model
Sensor sockets are configured as shown in the figure below.

<table>
<thead>
<tr>
<th>Sensor Socket</th>
<th>Sensor probes allowed for each sensor socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td>Reference</td>
</tr>
<tr>
<td>A</td>
<td>Temperature 9203</td>
</tr>
<tr>
<td></td>
<td>Soil temperature</td>
</tr>
<tr>
<td></td>
<td>Ultrasound (distance measurement)</td>
</tr>
<tr>
<td>B</td>
<td>Humidity 9204</td>
</tr>
<tr>
<td></td>
<td>Ultrasound (distance measurement)</td>
</tr>
<tr>
<td>C</td>
<td>Luminosity 9205</td>
</tr>
<tr>
<td>D</td>
<td>Noise sensor 9259</td>
</tr>
<tr>
<td>E</td>
<td>Dust sensor 9320</td>
</tr>
<tr>
<td>F</td>
<td>Linear displacement 9319</td>
</tr>
</tbody>
</table>

*Ask Libelium Sales Department for more information.

Figure 43: Sensor sockets configuration for Smart Cities model

Note: For more technical information about each sensor probe go to the Support section in Libelium website.
Smart Parking

Smart Parking allows to detect available parking spots by placing the node under the pavement. It works with a magnetic sensor which detects when a vehicle is present or not. Waspmote Plug & Sense! can act as a repeater for a Smart Parking node.

Figure 44: Smart Parking enclosure

Sensor sockets are no used for this model.

There are specific documents for parking applications at Libelium website. Refer to Smart Parking Technical guide to see typical applications for this model and how to make a good installation.
Smart Agriculture

The Smart Agriculture models allow to monitor multiple environmental parameters involving a wide range of applications. It has been provided with sensors for air and soil temperature and humidity (Sensirion), solar visible radiation, wind speed and direction, rainfall, atmospheric pressure, etc.

The main applications for this Waspmote Plug & Sense! model are precision agriculture, irrigation systems, greenhouses, weather stations, etc. Refer to Libelium website for more information.

Two variants are possible for this model, normal and PRO. Next section describes each configuration in detail.
Normal

Sensor sockets are configured as shown in the figure below.

<table>
<thead>
<tr>
<th>Sensor Socket</th>
<th>Sensor probes allowed for each sensor socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Humidity + Temperature (Sensirion) 9247</td>
</tr>
<tr>
<td>B</td>
<td>Atmospheric pressure 9250</td>
</tr>
<tr>
<td>C</td>
<td>Soil temperature 86949*</td>
</tr>
<tr>
<td>D</td>
<td>Soil moisture 9248</td>
</tr>
<tr>
<td>E</td>
<td>Soil moisture 9248</td>
</tr>
<tr>
<td>F</td>
<td>Soil moisture 9248</td>
</tr>
</tbody>
</table>

Figure 46: Sensor sockets configuration for Smart Agriculture model

* Ask Libelium Sales Department for more information.

Note: For more technical information about each sensor probe go to the Support section in Libelium website.

PRO

Sensor sockets are configured as shown in the figure below.

<table>
<thead>
<tr>
<th>Sensor Socket</th>
<th>Sensor probes allowed for each sensor socket</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Humidity + Temperature (Sensirion) 9247</td>
</tr>
<tr>
<td>B</td>
<td>Soil temperature 9255</td>
</tr>
<tr>
<td>C</td>
<td>Solar radiation 9251, 9257</td>
</tr>
<tr>
<td>D</td>
<td>Soil temperature 86949*</td>
</tr>
<tr>
<td>E</td>
<td>Soil moisture 9248</td>
</tr>
<tr>
<td>F</td>
<td>Soil moisture 9248</td>
</tr>
</tbody>
</table>

Figure 47: Sensor sockets configuration for Smart Agriculture PRO model

* Ask Libelium Sales Department for more information.

Note: For more technical information about each sensor probe go to the Support section in Libelium website.
Ambient Control

This model is designed to monitor main environment parameters in an easy way. Only three sensor probes are allowed for this model, as shown in next table.
Sensor sockets are configured as it is shown in figure below.

<table>
<thead>
<tr>
<th>Sensor Socket</th>
<th>Parameter</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Humidity + Temperature (Sensirion)</td>
<td>9247</td>
</tr>
<tr>
<td>B</td>
<td>Luminosity</td>
<td>9205</td>
</tr>
<tr>
<td>C</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Not used</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 49: Sensor sockets configuration for Ambient Control model*

**Note:** For more technical information about each sensor probe go to the [Support section](http://www.libelium.com/waspmote) in Libelium website.
Radiation Control

The main application for this Wasp mote Plug & Sense! configuration is to measure radiation levels using a Geiger sensor. For this model, the Geiger tube is already included inside Wasp mote, so the user does not have to connect any sensor probe to the enclosure. The rest of the other sensor sockets are not used.

Figure 50: Radiation Control Wasp mote Plug & Sense! model

Sensor sockets are not used for this model.

Note: For more technical information about each sensor probe go to the Support section in Libelium website.
Certifications

- CE (Europe)
- FCC (USA)
- IC (Canada)