GainSpan Smartplug Application Development Kit

OVERVIEW
The GainSpan Smartplug Application Development Kit (ADK) is a complete reference design that demonstrates a Smartplug application based on the GS1011M Wi-Fi module and the associated embedded and mobile software suite. The Smartplug ADK allows users to add Wi-Fi connectivity to a regular plug and control electrical load using a web browser on a PC or a smartphone. It provides a complete suite of embedded and mobile reference applications greatly ease, and shorten, development time.

The Smartplug application consists of two functions:
- Load Control to allow control of the load state (on/off)
- Power Measurement which provides measurement of the following parameters: voltage, current, frequency, instantaneous power, accumulated power consumption and power factor.

The GainSpan Smartplug ADK includes the smartplug hardware, a complete hardware design package, embedded software running on the GainSpan Wi-Fi module, web application and mobile reference applications for iOS and Android based smartphones. An evaluation version of the ADK, the Smartplug Application Evaluation Kit (AEK) is also available that will include the smartplug hardware and binary-only software.

The smartplug embedded software includes the smartplug application source code and Wi-Fi and networking stack binaries including mDNS/DNS-SD based discovery methods to discover devices and services available on the wireless network. The Smartplug mobile applications provide the graphical interface for controlling the electrical load and viewing electrical quantities in time series graphs on iOS or Android based smartphones. The smartplug mobile reference applications provide customers a foundation to rapidly build custom features suited to their end application.

OPERATIONAL MODES
The GainSpan Smartplug may perform as a limited access point (Limited AP mode) or as a client within an existing network infrastructure (Client/Station mode).

In Limited AP mode, the smartplug can connect with multiple smartphones (or PCs) as client/stations. When the smartplug is powered up in Limited AP mode, the clients can scan for all available wireless networks and select and connect to the smartplug Limited AP. Once the smartphone or PC has established connection with the GainSpan Smartplug, the mobile application discovers and selects a Smartplug service profile being advertised by the embedded application, and selects it to enable load control and display of electrical parameters. The mobile app also includes the charting function that displays these parameters in time series graphs.

In Client/Station mode, the GainSpan module and the smartphone connect to an AP as clients. The smartphone now discovers the smartplug embedded application profile, and upon selection, displays the electrical parameters and allows load control. The Client/Station mode supports the IEEE PS-Polling mode (consumption of 110uA in Sleep Mode on GS1011M) and is suitable for low-power applications.

BENEFITS:
- Complete Smartplug reference design to control electrical load and monitor and chart electrical parameters (voltage, current, power, frequency, power factor) using a web browser or mobile smartphones
- Accelerated time-to-market for development of new wireless smart energy applications such as smart plugs and smart power strips
- Quick and easy way to develop a wireless Smartplug application using GainSpan Wi-Fi modules and embedded/mobile software suite
- Provides embedded and mobile platform APIs and source code for customized smartplug application development
- mDNS/DNS-SD methods support discovery of smartplug devices and services available on the network without additional configuration

FEATURES:
- Smartplug ADK consists of the smartplug hardware, complete hardware design package, complete software suite including embedded software and mobile reference apps
- Smartplug AEK consists of the smartplug hardware and an evaluation, binary-only version of the software and iOS/Android mobile apps
- Smartplug embedded application operates in both Limited AP and Infrastructure client modes
- Smartplug embedded application exposes the SmartPlug resources using a HTTP server that can be accessed by web and mobile applications
- Smartplug embedded application advertises the smartplug application profile and allows automatic discovery by clients using mDNS/DNS-SD discovery methods
- Mobile Applications (iOS, Android) interact with the embedded application using discovery and HTTP APIs and show the current state of the Smartplug parameters and graphs of historical values collected during a session
- Charting function to monitor voltage, current, power, frequency and power factor over time
Both the Limited AP mode and client/station modes provide mDNS/DNS-SD based discovery methods. The smartplug embedded application advertises availability using these methods, and allows clients to automatically discover the smartplug profile. This makes it much easier for clients to locate and connect to smartplug applications on a network without the need to know the URL.

Provisioning of the GainSpan node in Limited AP or Client/Station modes can be done using web or mobile applications provided in the GainSpan Provisioning ADK. Over-the-air firmware updates of the GS1011M module-based Audio can be performed using web or mobile applications provided in the GainSpan Over-the-Air Firmware Update ADK. The smartplug ADK could be easily integrated with these GainSpan ADKs to support provisioning and over-the-air firmware upgrade.

**GAINSPAN SMARTPLUG ADK SOFTWARE**

The GainSpan SmartPlug ADK software allows an electrical load to be turned on or off and represents the state of the following variables -

- Power Measurement
  - Voltage
  - Current
  - Frequency
  - Power
  - Power Factor
- Load control (load)
  - State (state) – on/off

The SmartPlug application uses the embedded HTTP server functionality and responds to HTTP POST/GET requests initiated by a browser or a smartphone-based native application. Both the web and native applications are based on a RESTful architecture and communicate with the HTTP server using GET/POST methods and XML syntax. SmartPlug resources are represented as a URI and interaction with it is performed using HTTP GET/POST commands. Power Measurement parameters are read-only and therefore only the GET method is applicable for power measurement. The load state is the only parameter that can be modified, and hence both GET and POST methods can be used.

The Smartplug embedded firmware application runs on the GainSpan Wi-Fi module. It exposes the RESTful HTTP API and advertises the SmartPlug application profile, allowing automatic discovery by client applications using mDNS/DNS-SD (Bonjour) discovery methods. The mobile and web applications leverage discovery and the RESTful HTTP API exposed by the SmartPlug embedded application to fetch the state of SmartPlug variables or to turn load on/off.

The SmartPlug web application displays smartplug state variables in a browser and automatically refreshes the state according to the user configurable interval. The web application also allows the user to turn the load on/off. To enable service discovery, standard add-ons are available for Microsoft Internet Explorer (Bonjour Explorer bar) and Firefox (DNS-SD add-on).
The SmartPlug mobile applications present the smartplug state using a graphical interface. The graphical interface includes a charting function used to observe the variation of the smartplug state variables, load state and power measurement parameters, over time. The applications allow the user to modify the load state (on/off) and control the frequency of updates and other parameters related to charting.

**GAINSPAN SMARTPLUG HARDWARE DESCRIPTION**

The GainSpan Smartplug ADK includes a standard socket, single-phase 100-245V, 10A smartplug which uses a GainSpan GS1011M Wi-Fi module interfaced with the Prolific power measurement IC. The smartplug features the following components:

<table>
<thead>
<tr>
<th>Components</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>GainSpan Wi-Fi Module</td>
<td>GS1011M module streams smartplug data over Wi-Fi</td>
</tr>
</tbody>
</table>
**Prolific PL7223**
- Prolific power measurement IC

**Power Relays**
- Relay to turn load on/off

**Power Supply Unit**
- Provides power to GainSpan Wi-Fi module and Prolific PL7223 IC

**Serial Flash**
- Used for storage of provisioning or custom application web pages and/or backup firmware

**Switches and Buttons**
- Manual Load Control button, WPS and Restore Backup Firmware

**LEDs**
- Indicates Power On, Operation mode (Limited AP or Client) and Run/Program mode

**USB port**
- Used to power the board and upgrade firmware on the Wi-Fi module

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**HIGH VOLTAGE WARNING:**
The GND symbol on the schematics included in the ADK and AEK is NOT earth ground and is NOT safe to touch. The metal shield on the GainSpan module is NOT safe to touch. These are both connected to the AC Neutral power input. Touching this can cause severe electrical shock, resulting in serious injury or death. DO NOT connect test equipment grounds to the internal GND.
The USB voltage is isolated from the high voltage, and is safe to connect to a computer.

### SMARTPLUG ADK AND AEK CONTENTS

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<tr>
<th>Components</th>
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<th>AEK</th>
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<tr>
<td>Smartplug Embedded Firmware Application</td>
<td>Binary and Source</td>
<td>Binary Only</td>
</tr>
<tr>
<td>Smartplug Mobile Application for iOS/Android Smartphones</td>
<td>Mobile Application and Source</td>
<td>Mobile Application</td>
</tr>
<tr>
<td>GainSpan Smartplug</td>
<td>Hardware</td>
<td>Hardware</td>
</tr>
<tr>
<td>USB Cable</td>
<td>Hardware</td>
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**Note:** Smart Device is not included in the ADK or AEK.

### SMARTPLUG APPLICATION DEVELOPMENT MINIMUM REQUIREMENTS

<table>
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<th>Type</th>
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<td>GainSpan SDK Pro</td>
<td>Software Source, Tools</td>
</tr>
<tr>
<td>iOS Based Smart Device and Mobile Development Tools</td>
<td>Client Device, Tools</td>
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**Note:** SDK Pro is required to make any changes to the embedded application.

### SMARTPLUG ADK/AEK ORDERING INFORMATION

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