

GainSpan Thermostat Application Development Kit



OVERVIEW

The GainSpan Thermostat Application Development Kit (ADK) is a complete reference design that demonstrates a wireless Thermostat based on the GS1011M Wi-Fi module and the Renesas RL78L13 MCU. The Thermostat ADK enables developers to quickly and easily integrate wireless connectivity into a thermostat allowing users to view and control the thermostat settings, either locally using a PC or smartphone, or from the cloud via an infrastructure network. It provides an excellent starting point for development of Smart Thermostats that can learn from user behavior and surrounding thermal characteristics to program themselves, helping homeowners substantially lower home heating and cooling bills, and save energy.

The GainSpan Thermostat ADK includes a thermostat, a complete hardware design package, embedded software running on the GainSpan Wi-Fi module, host code running on the Renesas MCU and mobile reference applications for iOS and Android based smartphones. In addition to setting heat and cool temperature targets, the iOS and Android mobile applications included in the ADK allow users to set the time, view relative humidity and program temperature settings that can be applied to weekdays, weekends or selected days of the week. Settings can be saved into 4 pre-defined profiles and each can be programmed individually.

An evaluation version of the ADK, the Thermostat Application Evaluation Kit (AEK) is also available that includes the Thermostat hardware and binary-only software.

OPERATIONAL MODES

The GainSpan Thermostat can operate in two modes: 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 thermostat has a webserver running on the Wi-Fi module and can connect directly with multiple smartphones as client/stations. On power-up, clients can scan for all available wireless networks and select and connect to the Thermostat Limited AP. Once the smartphone has established connection with the GainSpan Thermostat, the mobile application discovers a Thermostat service profile being advertised by the embedded application, and selects it to enable wireless control of the thermostat settings.

In Client/Station mode, the Thermostat and the smartphone connect to an AP as clients. The smartphone now discovers the Thermostat embedded application profile, and upon selection, enables control of thermostat settings. In this mode, the Wi-Fi module runs both a webserver and a web client and allows direct control with a smartphone within the home network, as well as connecting and sending updates to the cloud. The Client/Station mode supports the IEEE PS-Polling mode and is suitable for low-power applications.

Cloud connectivity will be supported in Phase 2 software releases, planned for eo-Q42013.

BENEFITS:

- **Complete thermostat reference design to accelerate time-to-market for development of Smart “Learning” Thermostat applications**
- **Quick and easy way to design in wireless connectivity into your thermostat design to allow remote access to the thermostat**
- **Operation in Limited AP and client modes to provide ability to control locally or over the cloud using an infrastructure network**
- **mDNS/DNS-SD methods support discovery of Thermostat devices and services available on the network without additional configuration**

FEATURES:

- **Based on GainSpan Wi-Fi module and Renesas MCU and includes complete embedded and mobile software suite for customized Thermostat application development**
- **Thermostat ADK consists of the Thermostat hardware, complete hardware design package, complete software suite including embedded software and mobile reference apps**
- **Thermostat AEK consists of the Thermostat hardware and an evaluation, binary-only version of the software and iOS/Android mobile apps**
- **Thermostat embedded application operates in both Limited AP and Infrastructure client modes**
- **Mobile Applications (iOS, Android) interact with the embedded application using discovery and HTTP APIs and allow control of target temperature, setting time and programming schedules**
- **Schedules are stored in 4 pre-defined profiles**
- **Works with the HEMS Home Energy Management System**
- **Thermostat embedded application exposes the Thermostat resources using a HTTP server that can be accessed by web and mobile applications**
- **Thermostat embedded application advertises the Thermostat application profile and allows automatic discovery by clients using mDNS/DNS-SD discovery methods**

Both the Limited AP mode and client/station modes provide mDNS/DNS-SD based discovery methods. The Thermostat embedded application advertises availability using these methods, and allows clients to automatically discover the Thermostat profile. This makes it much easier for clients to devices to locate and connect to Thermostat 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 upgrades of the GS1011M module based thermostat can be performed using web or mobile applications provided in the GainSpan Over-the-Air Firmware Update ADK. The Thermostat ADK is integrated with these GainSpan ADKs to support provisioning and over-the-air firmware upgrades.

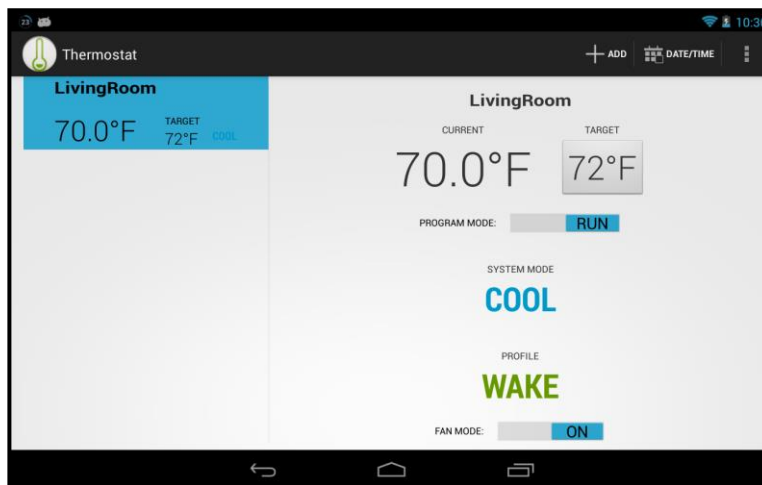
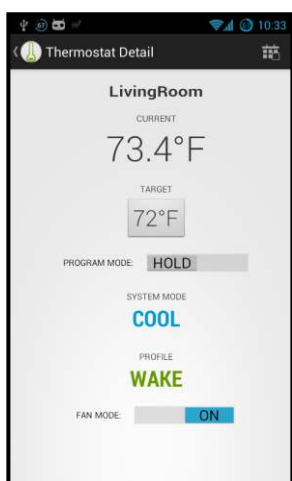
GAINSPAN THERMOSTAT ADK SOFTWARE

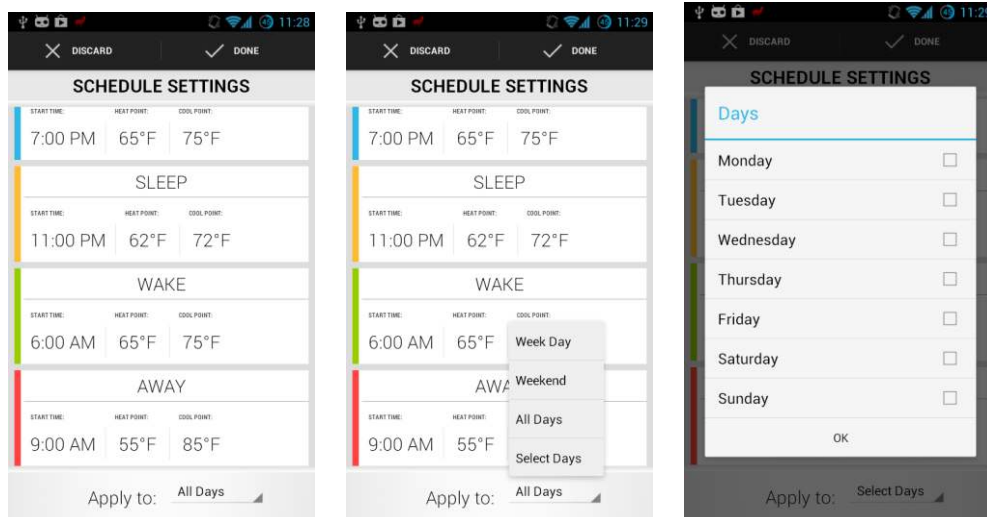
The ADK includes a complete suite of embedded firmware and mobile reference applications to greatly ease and shorten development time.

The Thermostat embedded software includes the thermostat application running on the Renesas MCU and Wi-Fi and networking stacks including mDNS/DNS-SD based discovery methods to discover devices and services available on the wireless network, provisioning and over-the-air firmware upgrades. The GSLink software, which is part of GainSpan's Serial-to-WiFi application software, allows communication between the RL78 host MCU and mobile app. It provides the mechanism to translate XML over HTTP into a format that can be easily parsed by the MCU. The iOS and Android mobile applications provide the graphical interface for controlling thermostat heat/cool settings and programming schedules.

The thermostat 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 mobile applications are based on a RESTful architecture and communicate with the HTTP server using GET/POST methods and XML syntax. Thermostat resources are represented as a URI and interaction with it is performed using HTTP GET/POST commands. The embedded firmware running on the Wi-Fi module exposes the RESTful HTTP API and advertises the Thermostat 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 Thermostat embedded application to control the thermostat.

The Thermostat mobile application allows users to change thermostat settings to heat/cool, set target temperatures, program schedules, turn fan on/off, or view relative humidity. The programmed temperature settings can be applied to weekdays, weekends or selected days of the week. Settings can be saved into 4 pre-defined profiles and each can be programmed individually. When user launches the app, the app discovers the thermostats in the connected network and then gets current data from each discovered thermostat and displays this on a "Summary" screen. Selecting any of the thermostats on the summary screen takes the user to the "Details" screen for that thermostat that allows users to monitor the thermostat and program settings. Please see "Thermostat Application Note" and "Quick Start Guide" for detailed description of the thermostat, the mobile app and usage.



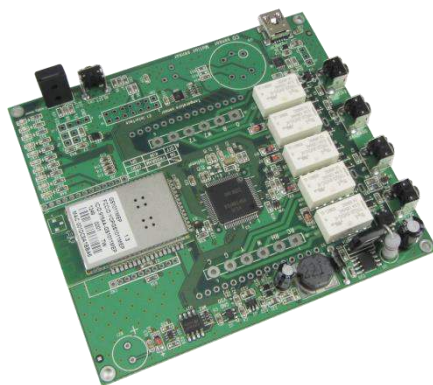


Thermostat Mobile Application (Android)

The Thermostat ADK works with the GainSpan HEMS (Home Energy Management System) ADK, which is an Android app that can be used to control multiple Thermostats and smartplugs that are all on the home network. The HEMS app allows selection of each device. Once selected, the device can be controlled/monitored using the appropriate mobile application.

GAINSPAN THERMOSTAT HARDWARE DESCRIPTION

The GainSpan Thermostat ADK features a wireless thermostat based on the GainSpan GS1011M Wi-Fi module and the Renesas RL78L13 MCU.



The Thermostat features the following components:

Components	Description
GainSpan Wi-Fi Module	GS1011MIP Wi-Fi module
Renesas MCU	Renesas RL78L13 MCU Host
Relays	Relays to turn load on/off
Buttons	4 Configuration buttons on the side of the thermostat unit (SEL, ENTER, UP, DOWN)

LCD Screen	LCD screen shows thermostat settings and along with the physical buttons located on the side of the thermostat, allows programming of the thermostat
USB port	Power cable used to power the board

THERMOSTAT ADK AND AEK CONTENTS

Components	ADK	AEK
Thermostat Embedded Firmware Application (MCU Host Software)	Binary and Source	Binary Only
Thermostat Mobile Application for iOS/Android Smartphones	Mobile Application and Source	Mobile Application
GainSpan Thermostat	Hardware	Hardware
USB Cable	Hardware	Hardware

THERMOSTAT HOST AND MOBILE APPLICATION DEVELOPMENT MINIMUM REQUIREMENTS

Requirements	Type
Renesas SDK	Software Source, Tools
iOS Based Smart Device and Mobile Development Tools	Client Device, Tools

THERMOSTAT ADK/AEK ORDERING INFORMATION

ITEM	PART NUMBER	Description
GainSpan Thermostat ADK	GS ADK-Thermostat	GainSpan Thermostat ADK based on GainSpan GS1011M Wi-Fi modules
GainSpan Thermostat AEK	GS AEK-Thermostat	GainSpan Thermostat AEK based on GainSpan GS1011M Wi-Fi modules