



Radio Thermostat Company of America

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Wi-Fi Application Developers Guide

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1 Introduction

The Radio Thermostat WiFi Application Developers Guide is a document to augment the information provided in the Radio Thermostat Wi-Fi API. This guide will define the various modes of operation of the Radio Thermostat platform of thermostats as well as offer guidelines for operations to control the thermostat.



Note

The API described in this document is for firmware version 1.04.64 (and above) and System API version 113 and Thermostat API version 100. This firmware can be used with Radio Thermostat's CT-80 v2.18, CT-30e v1.75 and 3M50 v1.09 thermostats. Please upgrade to firmware version 1.04.64, or later, before using this API.

1.1 General Architecture

The thermostat has two processors which communicate via a serial interface. The host processor is dedicated inside of the thermostat, and the processor running on the Wi-Fi module. The Wi-Fi module can be upgraded over-the-air, while the thermostat can only be upgraded with a physical connection.

1.2 Guidelines for using the guide

It is anticipated that this guide will grow and morph over time to include new functionality and new thermostats. In addition, it is our goal that user feedback will help shape this document going forward to include any pertinent information that may not be available at the time of initial release.

2 Glossary of Terms

2.1 Introduction

This section is designed to give an overview of the terminology used to describe the various functions of the thermostat

2.2 Definitions

2.2.1 Away

- ☐ Away is a short cut feature for use with the iPhone/Android App and web page.
- ☐ When you press the AWAY button - our server sends a message to the thermostat to go to a predefined temperature and then presses hold.
- ☐ You would use this feature if you are leaving the house for a period of time - but not exactly sure when you are coming back.
- ☐ Upon returning, you would resume the HOME mode. This will return the thermostat back to normal operation, running your program, with the hold released.

2.2.2 Holiday

- ☐ The Holiday Program with a WiFi module is a ONE day program that you can choose to run if you were to have an exception to your program
- ☐ This is a good feature to use if you are going to have a different schedule for a given day.
- ☐ The Holiday program is ideal to run for ONE day when you just need a temporary program change. The WiFi module will then return you back to the original program after ONE day.
- ☐ If you are using the WiFi module, many users might find it more flexible to just set up a second (or third) schedule on the website and flip back and forth between schedule as needed using the website.
- ☐ WITHOUT the WiFi module the holiday program will run until shut off.

2.2.3 Mode

- ☐ HEAT: The mode where your heater will turn on when your target temperature is ABOVE the room temperature.
- ☐ COOL: The mode where your air conditioner will turn on when your target is BELOW the room temperature.

2.2.4 Auto

- ☐ Automatically switches between the thermostats heat and cool programs appropriately
- ☐ Allows the freedom of setting any heat or cool program targets, regardless of mode, desired temperatures or desired time periods
- ☐ Auto is ideal for times when there are large temperature changes during the day, such as during the Spring and Fall seasons.
- ☐ At 3 degrees F ABOVE the HEAT target, the thermostat switches to COOL mode, however cool will not come on until the cool target is reached. Once reached the AC will come on and maintain that temperature.
- ☐ At 3 degrees F BELOW the COOL target, thermostat switches to HEAT mode. However, since the heat target is still below this temperature the heat will not come on until the target is reached.
- ☐ HEAT and COOL may also be set at the same target temperature.
 - At 3 degrees F above HEAT the COOL mode will be activated, and since the cool target is at or below this point, cool immediately turns on.
 - The same remains true for 3 degrees below COOL; HEAT will be activated and immediately turned on because its target is at or above the current temperature.

2.2.5 Temporary Override

- ☐ Temporary is a non-permanent change to the programmed target temperature
- ☐ If you are in temporary and you change the target, the target will be restored at the next program time boundary.
- ☐ If you don't want the temperature to change at the next time boundary - press the HOLD button to keep this constant target.

2.2.6 Hold Button

- ☐ Hold is used to keep the target temperature constant
- ☐ Hold is independent of the program temperature, and the target temperature will not change, unless you manually change it.
- ☐ The thermostat will remain on the held target temperature unless you return to the manual screen and deselect hold.

2.2.7 Fan Button

- ☐ The Fan has two states ON or AUTO
- ☐ ON fan indicates the fan is continuously running.
- ☐ AUTO fan means that your furnace will be turned on by the thermostat or furnace when there is a call for heat or cool.

2.2.8 Save Energy Button

- ☐ The SAVE ENERGY button is a one touch button that will apply a 4 degree offset to your target temperature
- ☐ If you are heating and the target is 74, when you press the Save Energy button the target will go to 70.
- ☐ This offset will apply across all program periods.
- ☐ Save Energy is useful when you will be gone for a short period of time.

2.2.9 Swing

- ☐ Swing is the difference between target and room temperature before the heat or cool will turn on
- ☐ In heat - if you set the Swing to be 1 degree with a target temperature of 68 - the heat will turn on when the room temperature reaches 67. The heat will then always turn off when it reaches the target of 68.
- ☐ The higher the SWING value, the longer it will take your system to turn on.
- ☐ Ideally, swing is the function used to control how often your heat will turn on depending on the amount of temperature fluctuation you allow.

2.2.10 Differential

- ☐ Differential is the difference between room temperature and target temperature where a second stage will turn on in a furnace or compressor with multiple stages
- ☐ Note: this will not show on the screen for single stage heating systems

2.2.11 Stages

- ☐ Some furnaces and compressors allow the thermostat to control the level of heating or cooling. A furnace might have 1 burner running in the 1st stage and 2 burners running in the second
- ☐ This will help control how quickly your house will heat or cool.
- ☐ Auxiliary Heat, or AUX, is often considered the second stage for heat pumps.

2.2.12 C Wire

- ☐ The "C" or "COMMON" wire is a dedicated wire to run power to the thermostat
- ☐ Every 24VAC furnace has a transformer that converts Line voltage (110V) to 24V that is use for the operation of furnace and control by the thermostat.
- ☐ The C wire is connected to one end of that transformer.
- ☐ The C wire is necessary to establish the WiFi connections with your home network. Without a constant supply of power the WiFi would drain the batteries too quickly.

3 General Operation

3.1 Timing Requirements

The underlying processor in the thermostat is a very low power device, and as such doesn't have a lot of headroom for excessive data request. It's best to keep queries spaced by at least 500ms, and would be better to space messages out further to 10s per requests. When using longer commands such as read and write program data, messages should be spaced by at least 15s.

Sending too many messages too quickly can potentially consume all of the resources on the Wi-Fi module. To recover for this situation you can either wait 20 minutes for the module to time out, or you can manually reset the module.

3.2 Thermostat Temperature State Machine

3.2.1 Introduction

The thermostat has a wide variety of options to control the target temperature. Fundamentally, the thermostat will always run its program. At a given time, the thermostat will adjust its target. There are two programs, one for heat and one for cool. The thermostat is always running one of these programs.

3.2.2 Temporary Target Override

The first exception to the thermostat is always running its program is the temporary target override. The temporary override, is just that – temporary. When you manually (or via the Wi-Fi API) change the target temperature, the thermostat will return back to the program target.

Note:

- ☐ Keep in mind that a user may change the target at any time, and the application should poll periodically to see if the target has been updated.
- ☐ Changing the time will clear any temporary targets and return the target back to the default program target

3.2.3 Hold

Hold will prevent the thermostat from changing targets at the next program boundary. Hold can keep the program target as the target permanently, or can make a temporary override permanent.

3.2.4 Vacation and Holiday

Vacation is a separate HOLD that will be stored as default value by the thermostat . Holiday is a one-day program that can run instead of the normal 7-day program. Holiday and Vacation are not exposed by the API and are not recommend for use in this application.

3.2.5 Absolute Targets

Absolute Targets will override any setting in the thermostat to calculate target and will not change at a program boundary. Using the Absolute targets will complete override the program. To return back to the program you can either set the target using the *t_heat* and *t_cool* API calls or disable the absolute targets.

3.3 Modes

You should always switch to off between switching modes. The application should never switch directly from heat to cool, or cool to heat. Switching between modes too quickly will defeat the thermostats lock outs to protect your HVAC system. The application should always wait at least 4 minutes between switching back to a mode. If you switch cool to heat, you should wait 4 minutes before switching from heat to cool.