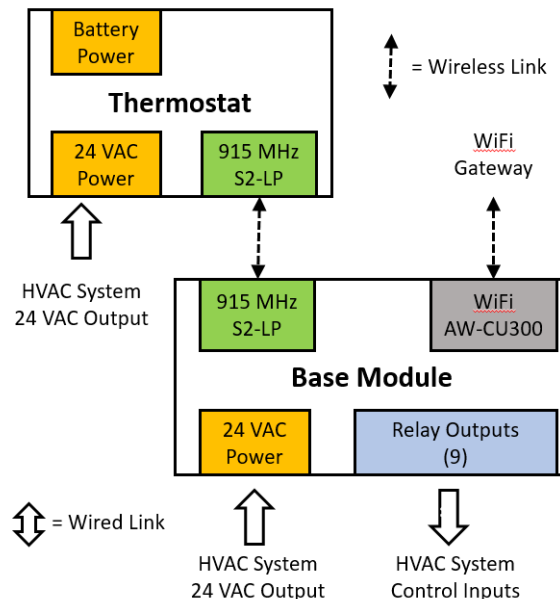


# Pro1 Wireless Thermostat and Base Module

## Theory of Operation

### Introduction

The Pro1 Wireless Thermostat and Base Module form a HVAC system controller designed to work with Packaged Terminal Air Conditioners (PTACs). The thermostat communicates with the base module using a 915 MHz, single frequency, wireless link. Both the thermostat and the base module contain a S2-LP transceiver from ST Microelectronics and both are set up to transmit and receive data to/from each other. The base module also contains an AW-CU300 WiFi module from Azurewave that is co-located with the S2-LP transceiver. The base module acts as a WiFi client to communicate with a WiFi access point (gateway) for remote monitoring and control. The thermostat may be powered by 2, AA batteries or connected to 24 VAC from the HVAC system. The base module is powered by 24 VAC from the HVAC system and does not have an option for battery power.



**Figure 1:** Thermostat/Base Module System

### 915 MHz Wireless Link

The 915 MHz wireless link uses a proprietary protocol is designed to meet FCC part 15 subpart 249 (FCC part 15.249). The S2-LP transceiver uses a 2-GFSK modulation scheme with a data rate of 4.8 kbps and a frequency deviation of 2.5 KHz. Depending on the mode of operation, the system can use up to 5All systems will communicate on the same TBD frequencyies in the 902-928 MHz ISM band. During initial setup, the thermostat and base module communicate on TBD frequency at the maximum system power output. Once the network is established, both the thermostat and base module monitor their RSSI and packet throughput. These inputs allow each transmitter to adjust to the lowest possible reliable power output for a given installation. Power output will never exceed the TBD maximum system output power

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~~but may be reduced as much as 40dB in steps of 5dB. channel 0 (915.0 MHz). Once setup is complete and the thermostat is “paired” to the base module, the frequency used will change to one of 4 pre-defined channels that is determined by the base module’s unique ID (915.1, 915.2, 915.3 or 915.4 MHz).~~  
The frequency channel does not change during normal operation.

During setup, a number of transmission events are triggered by the user activating push buttons on the Thermostat. The base module acknowledges each transmission in a form of wireless handshaking between the thermostat and base module. Once set up is complete, the system will enter normal operation.

Under normal operation, the thermostat will send environmental data (temperature, humidity, etc.) to the base module every second. Immediately after a transmission event from the thermostat, the base module is allowed to transmit data back to the thermostat if required. Since the thermostat must initiate all communications it may enter a low power sleep mode between transmission events.

The thermostat also contains motion detector and light sensor circuitry to determine if a room is occupied. In some cases, such as when motion is detected or a light transition occurs, the thermostat may transmit additional data to the base module between the 1 second updates. Software filtering is included to prevent continuous transmissions to the base module under these circumstances.

### 802.11 (WiFi) Wireless Link

The base module contains an Azurewave AW-CU300, certified WiFi module that operates in the 2.4 GHz ISM band. The module includes an integrated, printed circuit board antenna. The included u.fl connector is not used. Additional information about the module can be found at the following link.

[https://fccid.io/ANATEL/01874-16-03657/Manual\\_AW-CU300/5044DF1A-B9FB-49E3-9787-30161740DBFC](https://fccid.io/ANATEL/01874-16-03657/Manual_AW-CU300/5044DF1A-B9FB-49E3-9787-30161740DBFC)

### Host Microcontroller

Both the thermostat and the base module contain a host microcontroller operating from an internal oscillator. The host microcontroller communicates to the S2-LP 915 MHz transceiver using a SPI interface. For the base module, the host microcontroller communicates to the AW-CU300 WiFi module using a UART interface.

### Models

Pro1 desires to create multiple models for the thermostat and base module. All models are required to have the 915 MHz wireless link. In some cases, there may be models that do not have the WiFi module. Model derivations will consist of depopulating digital circuitry such as the humidity sensor circuitry, motion sense circuitry, light sense circuitry, user push button inputs, etc. It is Pro1’s goal to test the fully populated model (T755WO) as a worst case sample then add model derivatives with features removed as approved models to the report.