

RCT communication to microcontroller

1.0 Regulatory

The RCT-433-AS modules operate in the unlicensed 270-460 MHz band with some restrictions. That band is intended for applications like garage door openers and remote keyless entry devices.

It is very important that a new device does not deny access to those applications by transmitting continuously. For that reason, the FCC restricts operation to devices that do not operate continuously and prohibits transmission of voice or data, although there is an exception to the data rule. Generally, transmitters operating in this band are governed by part 15.231 paragraph a:

(a) The provisions of this Section are restricted to periodic operation within the band 40.66 - 40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

- (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
- (2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.
- (3) Periodic transmissions at regular predetermined intervals are not permitted.

Notice that there is an exception in paragraph e:

(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) and may be employed for any type of operation, including operation prohibited in paragraph (a), provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this Section, except the field strength table in paragraph (b) is replaced by the following: [table of allowable output power]. In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the **duration of each transmission shall not be greater than one second and**

the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

So basically, if your application can operate at a reduced output power, support a 30:1 off-time duty cycle, wait at least 10 seconds in-between transmissions, and have a maximum transmission time of 1 second, you can use the 260-470 MHz band. For most applications, these requirements are too restrictive. Most of the data applications we have seen in this band are wireless sensors that don't need an update rate of faster than 10 seconds. The cheap wireless temperature sensors and weather stations are good examples.

For most data applications, the 900 MHz band is a much better selection.

2.0 Technical

There are also some technical considerations when sending data with the RCT-AS series of modules.

2.1 UARTs

A UART's idle state is marking, or high. This is important because of the way that the RCT-AS module works.

The data input to the module is essentially connected directly to the base of the oscillator transistor. When the base is low, the transistor is off, thus the transmitter is off. When the base is high, the transistor is on, and therefore the transmitter is on. So, if the transmitter were connected directly to the UART, it would be on when no data is being sent, which violates the FCC rules.

For this reason, the output of the UART must be inverted before the transmitter so that when the UART's output is high, the transmitter is off. The output of the receiver would also need to be inverted to recover the original data from the transmitting UART.

2.2 Data Rate

The maximum data rate of the RCT-AS module is 4800 baud. This is determined by the start-up time of the oscillator. The start-up time of the oscillator is affected by the antenna. It is important for the antenna to present a true 50-ohm resistive load in order to assure the start-up time will support operation at this data rate.

If the startup time increases, it will affect the width of a high bit at the receiver. The bit time will be reduced. So, the one bits will be shorter than the zero bits. This can cause problems with UARTs if the bit times shrink enough.

2.3 DC balanced data

When you send data using a RCT-AS transmitter and receive it with a RCR series receiver, you are essentially AC-coupling the data stream. This means that the data cannot have DC (or zero hertz) components. For example, long strings of 1's and 0's would not be received properly.

To overcome this limitation, a DC balanced encoding scheme such as manchester should be used. Or, if a UART is being used, a 4-bit to 6-bit encoding scheme can be used. For more information on a 4-to-6-bit encoding scheme, refer to AN401.