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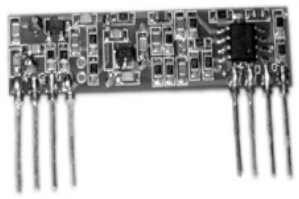
RCR-433-RP

- ***Designed for Short-Range Remote Control Applications***
- ***Works with any LC or SAW Based Transmitter***
- ***-102 dBm Sensitivity***
- ***>250 foot operating range***

Low-Cost 433.92 MHz Super-Regen ASK/OOK Receiver



The RCR-433-RP is ideal for short-range remote control applications where cost is a primary concern. The receiver module requires no external RF components except for the antenna. It generates virtually no emissions, making FCC and ETSI approvals easy.

The super-regenerative design exhibits exceptional sensitivity at a very low cost. A SAW filter can be added to the antenna input to improve selectivity for applications that require robust performance.

The manufacturing-friendly SIP style package and low-cost make the RCR-433-RP suitable for high volume applications.

APPLICATIONS

- *Remote Keyless Entry (RKE)*
- *Remote Lighting Controls*
- *On-Site Paging*
- *Asset Tracking*
- *Wireless Alarm and Security Systems*
- *Long Range RFID*

KEY FEATURES

- *Low-Cost*
- *3 MHz receiving bandwidth - works with any LC or SAW based transmitter*
- *5V operation, 4.5 mA current*
- *Small-size: 1.76" x .43"*
- *No external parts are required*
- *4800 baud operation*

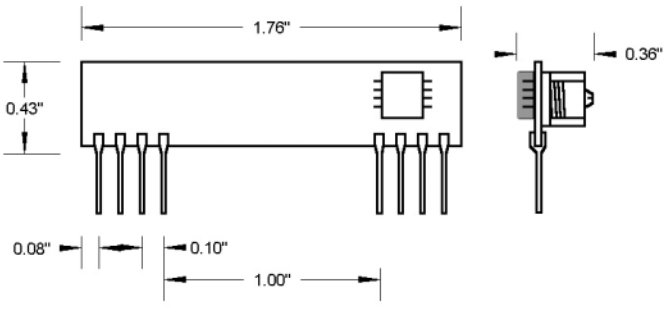


Figure 1. Mechanical Drawing

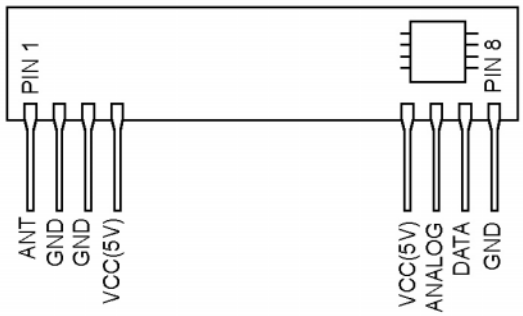


Figure 2. Pin-Out Diagram

Absolute Maximum Ratings

Rating	Value	Units
Power Supply and All Input Pins	-0.3 to +12	VDC
Storage Temperature	-50 to +100	°C
Soldering Temperature (10 sec)	350	°C

Electrical Characteristics

Characteristic	Symbol	Min	Typ	Max	Units	Notes
Operating Voltage	V_{cc}	4.5	5.0	5.5	VDC	none
Operating Current	I_{cc}	---	4.5	---	mA	none
Reception Bandwidth	BW_{rx}	---	3.0	---	MHz	none
Center Frequency	F_c	---	433.92	---	MHz	none
Sensitivity	none	**---**	-102	**---**	dBm	none
Baud Rate - NRZ	none	1200	---	4800	BPS	none
Baud Rate - PWM	none	120	---	2400	BPS	none
Audio Bandwidth	BW_{audio}	.15	**---**	2.8	kHz	none
Selectivity	none	TBD			TBD	TBD
Operating Temperature Range	T_{op}	-20	**---**	+70	°C	TBD

Pin Description

Pin	Name	Description
1	ANT	50 ohm antenna input.
2	GND	Receiver ground. Connect to ground plane
3	GND	Receiver ground. Connect to ground plane.
4,5	VCC(5V)	Pins 4 and 5 are electrically connected and provide operating voltage for the reciever. VCC can be applied to either or both. VCC should be bypassed with a .01uF ceramic capacitor and filtered with a 4.7uF tantalum capacitor. Noise on the power supply will degrade receiver sensitivity.
6	ANALOG	Analog receiver output. This is the audio signal prior to the data slicer.
7	DATA	Digital data output. This output is capable of driving one TTL or CMOS load. It is a CMOS compatible output.
8	GND	Receiver ground. Connect to ground plane.

Theory of Operation

Super-Regenerative AM Detection

The RCR-433-RP uses a super-regenerative AM detector to demodulate the incoming AM carrier.

A super-regenerative detector is a gain stage with positive feedback greater than unity so that it oscillates. An RC-time constant is included in the gain stage so that when the gain stage oscillates, the gain will be lowered over time proportional to the RC time constant until the oscillation eventually dies. When the oscillation dies, the current draw of the gain stage decreases, charging the RC circuit, increasing the gain, and ultimately the oscillation starts again. In this way,the oscillation of the gain stage is turned on and off at a rate set by the RC time constant. This rate is chosen to be super-audible but much lower than the main oscillation rate.

Detection is accomplished by measuring the emitter current of the gain stage. Any RF input signal at the frequency of the main oscillation will aid the main oscillation in restarting. If the amplitude of the RF input increases, the main oscillation will stay on for a longer period of time, and the emitter current will be higher. Therefore, we can detect the original baseband signal by simply low-pass filtering the emitter current.

The average emitter current is not very linear as a function of the RF input level. It exhibits a 1/ln response because of the exponentially rising nature of oscillator start-up. The steep slope of a logarithm near zero results in high sensitivity to small input signals.

Data Slicer

The data slicer converts the baseband analog signal from the super-regenerative detector to a CMOS/ TTL compatible output.

Because the data slicer is AC coupled to the audio output, there is a minimum data rate. AC coupling also limits the minimum and maximum pulse width.

Typically, data is encoded on the transmit side using pulse-width modulation (PWM) or non-return-to-zero(NRZ).

The most common source for NRZ data is from a UART embedded in a micro-controller. Applications that use NRZ data encoding typically involve micro-controllers. Refer to the RCR-433-RP designer's guide for more information on using NRZ data encoding.

The most common source for PWM data is from a remote control IC such as the HC-12E from Holtek. Data is sent as a constant rate square-wave. The duty cycle of that square wave will generally be either 33% (a zero) or 66% (a one).

The data slicer on the RCR-433-RP is optimized for use with PWM encoded data, though it will work with NRZ data if certain encoding rules are followed.

Power Supply

The RCR-433-RP is designed to operate from a 5V power supply. It is crucial that this power supply be very quiet. The power supply should be bypassed using a 0.01uF low-ESR ceramic capacitor and a 4.7uF tantalum capacitor. These capacitors should be placed as close to the power pins as possible.

The RCR-433-RP is designed for continuous duty operation. From the time power is applied, it can take up to 750mSec for the data ouput to become valid.

Antenna Input

Pin 1 is a 50 ohm antenna input. It will support most antenna types, including printed antennas integrated directly onto the PCB.

The performance of the different antennas varies. Please refer to the applications note "Antennas 101" for more information on antennas. This applications note also includes information on microstrip transmission lines. Any time a trace is longer than 1/8th the wavelength of the frequency it is carrying, it should be a 50 ohm microstrip.