

APPLICATION NOTE 1773

Designing Remote Keyless Entry (RKE) Systems

Abstract: This application note describes how RKE systems work and ways to meet the primary design challenges, which are low power consumption, RKE transmit-receive range, and reliability. Maxim parts designed to address these concerns are also presented.

Additional Information:

- [Remote Keyless Entry Systems Overview](#)
- [How to Modify an Existing Design from a TDA5200 or TDA5201 to a MAX1470 Superheterodyne Receiver](#)
- [How to Choose a Quartz Crystal Oscillator for the MAX1470 Superheterodyne Receiver](#)
- [How to Tune and Antenna Match the MAX1470 Circuit](#)
- [Where to Go for Regulations Concerning Short-Range Devices \(SRD\)](#)

Remote keyless entry (RKE) systems allow a user to lock and unlock the car using a transmitter on the keychain, which transmits data to a receiver in the vehicle. (See also: [Remote Keyless Entry Systems Overview](#)).

This application note describes how RKE systems work and ways to meet the primary design challenges, which are low power consumption, RKE transmit-receive range, and reliability.

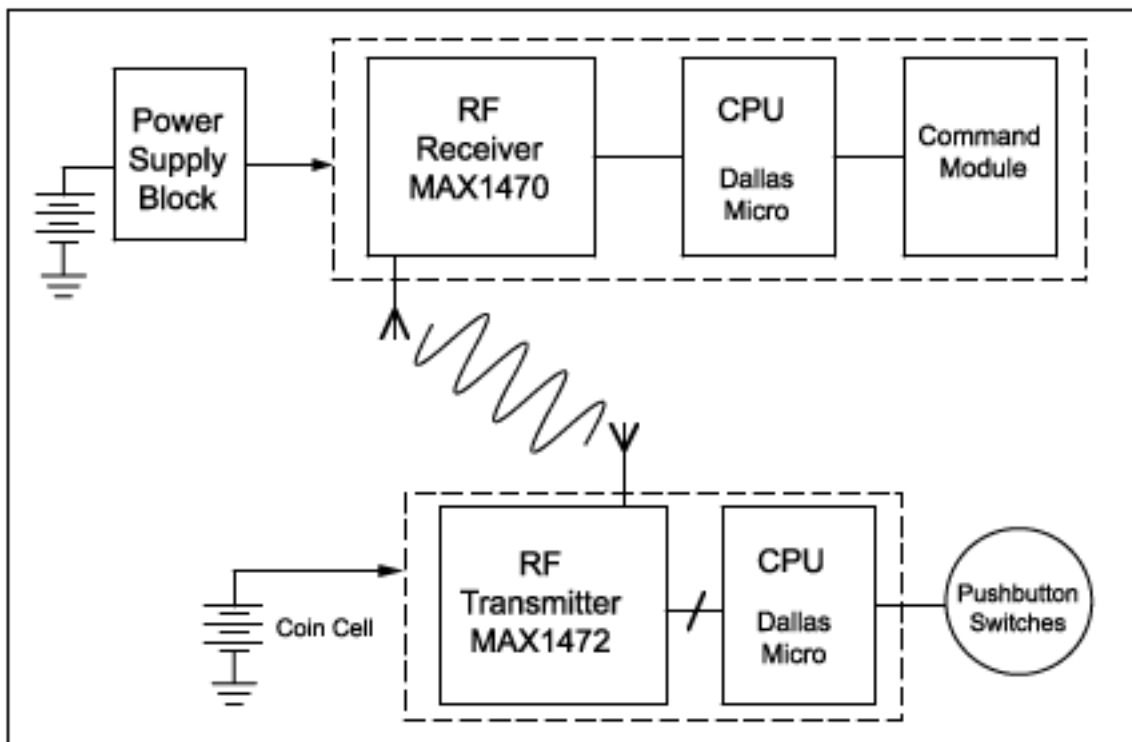


Figure 1. Block diagram for remote keyless entry (RKE) systems.

As can be seen in the RKE block diagram, the user presses a pushbutton switch on his key fob to initiate an action. This wakes up the CPU inside the RKE key fob, which sends a data stream to the RF transmitter. The data stream is usually 64 to 128 bits long and includes a preamble, a command code and a rolling code. It is sent at a rate usually between 2kHz and 20kHz. The modulation scheme is amplitude shift keying (ASK), mainly to extend

the key fob's battery life.

The RKE's RF receiver in the vehicle captures the RF signal, demodulates it and sends the data stream to the CPU, which decodes it and sends commands to the command module.

Remote Keyless Entry Design Challenges

The challenge in designing a remote keyless entry system is achieving a low cost system that is robust and reliable with low current consumption. Battery life is important for both transmitter and receiver.

Power Considerations

For the transmitter, battery life of 3–5 years is desirable. Battery life is also important for the receiver, as the receiver must always be on, listening for the user's transmission. Typical specs call for no more than 1mA of average current. One way system designers solve this problem is by leaving the receiver on for brief periods of time, long enough to determine if there's a valid transmission. The receiver "sleeps" the rest of the time. The receiver must be able to wake-up very fast, to maximize the energy saved.

Performance: Range and Reliability

Remote keyless entry applications require good transmit-receive range and reliable transmission. Increased receiver sensitivity and high transmit power (without an appreciable increase in current consumption) directly impact range and reliability. Low price is an obvious requirement, as there are millions of these systems being installed.

Selecting Parts

Maxim understands these concerns and has a series of parts to address the needs of remote keyless entry system designers. The MAX1472 transmitter and the MAX1470 and MAX1473 receivers were specifically designed with these requirements in mind.

The MAX1473 is the industry's first 300MHz–450MHz super-heterodyne ASK receiver featuring high sensitivity of -114dBm, user-selectable center-frequency image rejection of better than 50dB and the option of running from either 3V or 5V supplies. The part draws less than 1.5mA in shut down mode and only 5.2mA in receive mode. The MAX1473 is capable of receiving data rates up to 100kbps and transitions from shut-down to valid data out in less than 250µs. The MAX1473 includes a one-step AGC circuit that drops the LNA gain by 35dB when the RF Input signal is greater than -57dBm. The receiver uses a 10.7MHz IF filter with received-signal-strength-indicator (RSSI) and has an on-chip phase-locked loop and VCO and analog base-band data recovery circuitry. The MAX1473 is housed in a 28-pin SSOP package and is offered at \$1.95 in quantities of 10,000.

The MAX1470 is very similar to the MAX1473 but lacks the AGC and can only run off 3V supplies. The MAX1470 is as such less expensive than the MAX1473 and is priced at \$1.65 in quantities of 10,000.

The MAX1472 is the industry's smallest VHF/UHF PLL-based ASK-transmitter, housed in the tiny, 3mm × 3mm 8-pin SOT-23 package. The transmitter is perfect for low-cost, high-volumes applications where space is critical such as remote keyless entry operating in the 300MHz–450MHz band. The MAX1472 is designed to run directly off of a lithium cell as it will operate down to 2.1V consuming only 100nA of current in stand-by mode. During transmission, the MAX1472 can output from -10dBm to +10dBm of power into a 50Ω load. For a +10dBm power level, the MAX1472 consumes 5.5mA of current at 315MHz when using a 50% duty-cycle encoding scheme, such as Manchester. Current consumption drops to 3mA at 0dBm output. The part can accept data rates up to 100kbps.

Once the enable pin of the MAX1472 is activated, the MAX1472 takes only 250µs for the PLL and crystal to settle and be available to transmit. Because the part is targeted at small, portable applications, the MAX1472 will accept crystal frequencies between 10MHz–15MHz, widely available in inexpensive, surface mount packages.

As the MAX1472 uses a crystal-based PLL, most of the problems of an LC or SAW-based transmitter are eliminated. The inherent accuracy of the crystal frequency allows for a narrower IF-bandwidth in the receiver to improve system sensitivity. With a receiver like Maxim's MAX1470 or MAX1473, an improvement in sensitivity of 9dB is possible simply by narrowing the IF bandwidth from 600kHz to 50kHz. Improved sensitivity translates directly to greater range or more reliable transmissions for your product. The MAX1472 is priced at \$1.39 in quantities of 1,000.

Application note 1773: www.maxim-ic.com/an1773

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