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# Secura Key Radio Key® Technology

## What is Radio Key®?

Radio Key® is Secura Key's brand name for its 125 kHz Proximity Card Technology. Radio Key® cards, keytags, and readers using Proximity technology are ideally suited for a wide variety of applications including access control, time and attendance, membership, parking, fuel management, and more.

Radio Key® readers are designed to work with standard access control panels that provide an SIA Wiegand interface. When a factory programmed Radio Key® card is presented, the reader provides the panel with a facility code and card ID number in a standard Wiegand format. The panel provides feedback to the cardholder by using the reader's control lines to operate the red/green LED and audible beeper.

Radio Key® Standalone Readers are self-contained units designed to control access to a single door. These units have a card reader, and also have a local database that stores card ID numbers and Keypad PIN numbers, which can be added or deleted by the user. They also have a relay for controlling the door locking device, and inputs for a request-to-exit switch.

Radio Key® Smart Readers are designed to work with custom software applications developed by original equipment manufacturers and systems integrators. The reader's solid state relay, beeper and LED can be operated by serial commands from the host, and the host can monitor its inputs. Smart Readers can be used for access control, process control, and many other applications.

This document is an overview intended to familiarize applications providers, consultants, resellers and end users with the capabilities of Radio Key®. To help implement new applications, Secura Key offers factory support.

## Terminology

Technically speaking, a Radio Key® card or keytag is a Low Frequency RFID Transponder. RFID stands for *Radio Frequency IDentification*. A *Transponder* is an automatic device that transmits a predetermined message in response to a predefined received signal.

The term *Proximity* is commonly used for low frequency transponders and readers which identify people for access control, whereas the term *RFID* is typically associated with transponders which identify assets.



Glass-encapsulated Low Frequency RFID Transponders have been used for many years for livestock identification. Low-Frequency technology is also used for automatic payment systems – the most popular being the Mobil Speedpass®. These tags provide a read-only ID number to the system – there is no stored value or data on the tag.

Proximity is used for access control when good security is required, but additional applications are not required on the card. Proximity cards provide excellent read range, and are not affected by the body of the cardholder, or by metal in a keychain, for example.

## **Basic Operation**

Radio Key® proximity cards and keytags are passive devices, meaning that they do not require a battery. The card contains a copper air coil antenna and a chip, or more technically, an RFID ASIC or *Application Specific Integrated Circuit*. The reader emits RF energy at 125 kHz, which is coupled into the ASIC by the card antenna, powering the ASIC. Once the ASIC is powered up, it transmits its encoded number to the reader by damping (or loading) the reader's RF field in a repeating pattern. This causes a ripple in the reader's RF circuit, which the reader demodulates and structures into a Wiegand formatted card number, which it transmits to a control panel.

Although the card number is continuously repeated as long as the ASIC remains in the reader's RF field, an access control reader will only output the card number once, unless the transponder is removed from the RF field for more than one second and re-presented – this prevents access control processing errors such as duplicate transaction records or anti-passback violations.

Secura Key's Radio Key® 125 kHz proximity technology is similar to competitors such as HID, Indala, Keri, AWID and others, but it offers better performance.

Secura Key's proximity readers feature Dynascan®, which is a patented auto tuning circuit that constantly checks and re-tunes the readers to their environment. Dynascan® allows Secura Key proximity readers to obtain significantly better read range than similarly sized competitive units. For example, the RK-WM S-shaped mini-mullion readers get up to 6 inches of read range, while similar competitive readers get up to 3 inches of read range. The RK-WL Long Range reader gets up to 36 " of read range with an RK-CM passive clamshell card, while drawing only 350 mA peak at 12 VDC. Competitive long range readers get up to 24" of read range with a passive clamshell card, and they require 1.2 Amps peak @ 24 VDC to obtain maximum read range.

Like many proximity cards, Radio Key® proximity cards and tags use the Atmel/Temic 5557 chip, connected to a copper wire air coil antenna. This chip (or a functional equivalent made by EM-Marin) is used in cards from HID, Indala, AWID, WSE and many others. The chip can be configured to use different modulation techniques, such as frequency shift keying (FSK), pulse shift keying (PSK) and amplitude shift keying (ASK). Radio Key® uses ASK.

## **Industry Standards**

There are no applicable industry standards for proximity technology. Each manufacturer uses a proprietary method to communicate between the reader and the card.

While some manufacturers offer special readers with multi-technology capability, generally speaking, if you buy proximity readers from one company, you must also purchase the cards from the same company.

There are industry standards for access control data encoding and for interfacing readers to control panels. Most proximity cards in use for access control are encoded in the SIA (Security Industry Association) standard 26-bit unencrypted format, and most readers output the data via the SIA standard Wiegand interface. However, proximity cards encoded with 26-bit Wiegand data will not necessarily work with any brand of reader, for the reasons mentioned above.

## Security

Proximity technology is a mature technology, and typically has no security or encryption built into the card itself, although it is possible to encrypt card data prior to encoding and decrypt the data in the reader or control panel. Radio Key® card data is not encrypted, and it is transmitted to the reader, and then to the panel exactly as it was encoded. A few companies use encryption to protect custom formats, or to restrict cards to specific sites, but this capability is not widely used, and generally creates field support issues. NXP offers an encrypted proximity technology called HITAG, but it is not widely used, due to the added cost of an NXP decryption chip for every reader.

Despite the lack of encryption, Proximity cards are still relatively difficult to duplicate, because encoders and unencoded cards are not available through distributors and dealers.

## Radio Key® Readers

Radio Key® readers are available in several form factors and colors. Radio Key® reader products can be classified in three groups: read-only Wiegand Output models, Stand Alones, and Smart Readers.

### Wiegand Output Readers

Secura Key offers three models of proximity Access Control readers that can be used with any Access Control panel that uses the SIA Wiegand Interface:

RK-WM	Mullion-Mount Reader (Black)
RK-WS	Wall-Mount Reader (Black or Beige)
RK-WL	Long-Range Reader (Black or Beige)



**Fig. 1 – Wiegand Output readers**

Secura Key readers and cards can be used in place of other OEM reader products, such as Keri, AWID, Indala or HID<sup>1</sup>. They offer

- the same or better performance
- the same voltage and current requirements,
- the same Wiegand output formats (up to 40 bits)
- the same wire colors
- the same input/output functions

## Stand Alone Readers

Stand Alone readers are self-contained units which control access to a single door, and allow the user to enroll or delete individual proximity cards (or PINs) from the unit. These units have a strike relay, which operates an electric door-locking device. Secura Key offers four Stand Alone models

RK600	Wall switch keypad/prox reader, stores 600 cards or PINs
RK600E	Same as RK600, but without PIN keypad
RK65K	Mini-Mullion reader, stores 65,000 cards
RK65KS	Same as RK65KS, but in larger Wallswitch form factor



**Fig. 2 – Standalone Readers**

The RK600 and RK600E have an add-on module, which has a real time clock, memory for transaction history storage, and an interface to a PC. RK-LINK™ Software allows the user to view history, to program the reader from the PC, and to copy programming from one reader to another. The RK600 can also be programmed from its own keypad, while the RK600E can be programmed with the RK-HHP passive hand-held RF programmer.

The RK65K/RK65KS is only programmed via the passive hand-held programmer. It does not store transaction history or interface to a PC, but it has a much larger cardholder capacity than the RK600, and it also has a Wiegand data output, allowing simultaneous use with an access control system, or a future “upgrade” from a standalone to an access control system by the addition of control panels and software.

The RK-HHP hand held programmer offers a novel use for proximity technology. It is a passive device that contains a keypad and a matrix of specially programmed proximity transponders. Each key press connects a unique combination of transponders to the antenna circuit, producing RF data that is decoded by the stand-alone reader as keypad input, and is used to program the reader.

## Smart Readers

Radio Key® Smart Readers are designed to work with custom software applications developed by original equipment manufacturers and system integrators. The readers communicate with the host via RS-485, and up to 100 units can be connected via RS-485 twisted pair to a PC or microcontroller for a host-validated system. The network can have a maximum length of 4000 feet. The reader has a solid-state relay, plus two inputs, allowing

<sup>1</sup> Secura Key readers are only compatible with Secura Key cards, so they should be used for new installations only – they cannot be retrofit into existing installations where other brands of cards and readers are in use.

access control or process control without panels or additional hardware. The host system can read the card over the RS485 network. The host system also controls timed relay activation, LED and beeper activation.



**Fig. 3 – Smart Readers**

The Radio Key® Smart Reader is available in two weatherproof configurations: the RK-XRM (Mullion reader) used on door frames, mullions, limited space applications; and the RK-XRS (wall switch reader) used on US J-boxes or post mount adapters.

### **Readers and Safety**

Radio Key® readers meet FCC Class B standards for radiated emissions (approved for residential use) and do not present a health hazard to the user. The readers do not emit full power all the time, but operate on a 10% duty cycle until they sense the presence of a card.

### **Power Supplies**

Radio Key® readers require a clean DC power supply for best performance. A noisy power supply may couple excessive RF noise into the reader, interfering with the card reading process, and resulting in reduced read range. A linear supply is preferred, but a low-noise switching power supply will work equally well. The RKWL long-range reader is very sensitive to noise, and requires a high-quality low-noise power supply; such as Secura Key model SK-DCPWR.

### **Readers and Performance Optimization**

Although the Dynascan® feature tunes Radio Key® readers to their environment, proximity readers will work better if there is less metal nearby. Ferrous metal tends to absorb the RF radiation from the reader, leaving less energy to power the card, meaning that the card must be brought closer to the reader to operate.

When mounted on a metal building or metal post-mount flange, a non-metallic spacer should be installed between the proximity reader and the mounting surface to achieve the best read range. Buried loop detectors used for parking gates are frequently noisy, and this RF noise may interfere with the proximity reader, resulting in reduced read range. Consult the loop detector manufacturer for tuning or filtering options, or reposition the loop detector or reader. For parking lane installations, it is advisable to do some preliminary tests for the best location and orientation of the reader before permanently mounting it.

### **Radio Key® Credentials**

Radio Key® Cards, Key fobs and mini-disc transponders can store up to 40 bits of Wiegand formatted card data. Credentials are laser-engraved with the card ID and facility code.

Radio Key® credentials are available in four form factors: ISO Cards, Clamshell Cards, Key Fobs, and Mini Disc.



**Fig 4. Radio Key® Credentials**

**RKCI ISO Card** - These white, glossy, laminated PVC cards meet CR80 and ISO 7810 standards for size and thickness, and can be printed on both sides, using a dye-sublimation or thermal transfer card printer. See card printing guidelines in the Card Ordering Guide on the Secura Key website. They can also be slot punched for vertical (portrait) or horizontal (landscape) orientation. The access control ID number is laser engraved on the card. They are NOT embossable.

Radio Key® RKCI cards are also available with a magnetic stripe which can be encoded by the reseller or end user. Secura Key does not encode the magnetic stripe.

**RKKT Key Tag** - These rugged, black oval shaped Polycarbonate key tags include a hole for use with most key rings. The access control ID number is laser engraved on the tag. The 2.0" x 1.26" size allows for a larger antenna than most proximity keytags, which provides superior read range. Custom printing is not available.

**RKCM Clamshell Card** - These cards designed for rugged use, and have a molded ABS base, which holds the RF ASIC and copper antenna, a PVC cover sheet, and a slot molded into the card for vertical (portrait) orientation. These cards cannot be directly printed in a dye sublimation printer, but can be printed by a reverse-transfer printer (such as Fargo HDP), or adhesive-backed labels (RKCM-IDL) can be printed separately in a dye sublimation printer and manually applied to the top cover of the card. RKCM cards are credit card sized, but are 0.065 thick to provide added strength. Secura Key uses a custom designed card base to allow heavier copper windings in the antenna, which provides superior read range.

**RKMT Mini Disc** - The Mini Disc consists of a circular copper air coil antenna and an ATME/Temic 5557 series 125 kHz RFID ASIC. The components are laminated in a PET disc package, 0.73" in diameter and 0.028" thick. While currently used inside battery powered key fob gate transmitters, the disc can be inserted into any device to add proximity technology.

### **Cards and Safety**

Radio Key® cards do not constantly transmit data, and do not present a health hazard to the user. The cards do not contain ferrous material, but if they have a metal spring clip or retractor, they should be removed when entering an MRI area. The cards should not be laundered, and should not be placed in a microwave oven. Keytags should not be laundered or submerged in water – if the keytag housing fills with water, the tag will stop working until the water evaporates.

Radio Key® cards contain an integrated circuit and an antenna. While they are fairly rugged and will last a long time if properly treated, they should not be bent back and forth, or subjected to strong impact, poked with a pen or pencil, or otherwise abused. If the antenna is broken or if the chip is cracked, the card will stop working.

## **Printing Cards**

Radio Key® RKCI ISO cards can be printed in a dye sublimation printer. Card artwork designs should avoid areas of solid color or light screened patterns, as this tends to reveal the electronics embedded in the card. Make a test run of a new card printing design before printing all of your cards, and be prepared to make adjustments in the layout to avoid printing critical graphics in the area of the card chip. Dye Sublimation printing will not damage or warp the card if the printer is functioning properly. However, if a clear polyester overlay is applied, the heat used in many overlay laminators may cause the card to warp.

Radio Key® RKCM Clamshell cards cannot be printed in standard dye sublimation printers, but they can be printed in some special printers (such as Fargo HDP) which reverse-print the image onto clear plastic and then laminate the image onto one or both sides of the card.

Secura Key does not currently offer custom in-house card printing capabilities for its Radio Key® ISO and clamshell cards to dealers and distributors, but custom logo branding is available to OEMs who wish to order in large quantities.

## **Card Encoding**

Radio Key® proximity cards are encoded with an ID number and facility code, which is used by the access control system to locate a cardholder record where access privileges are stored for each reader. These cards have a relatively small data storage capacity, and are not practical for read/write applications, due to the lower data transmission frequency. (Secura Key does not offer a reader/writer for Proximity cards.)

Secura Key offers proximity cards encoded with either 26-bit SIA or 32-bit Secura Key Wiegand formats. The Secura Key 32-bit format is recommended because it is less widely used, and because it offers many more unique facility codes than 26 bit, reducing the possibility of duplicated cards. Secura Key can provide cards encoded with any OEM Wiegand format up to 40 bits – call the factory for information.

## **Hardware Interface (Wiegand Output)**

Radio Key® Wiegand output readers are equipped with an 18" unshielded 22AWG wire pigtail, with wire colors and functions shown in Table 1. The cable is permanently connected to the reader.

## **Power**

As with all RFID readers, noise on the DC input power will affect performance and read range, so a good quality DC supply should be used.

The RK-WM and RK-WS Radio Key® readers accept either a 5 or 12 VDC power supply, and can operate over a range of 5-14VDC. Power consumption is about 40/90 mA avg./max. The RK-WL long-range reader requires 300/350 mA avg./max at 12-14 VDC.

## **Wiegand Connections**

Wiegand connections meet the SIA Wiegand standard, which has two lines for Wiegand data: Data 0 and Data 1. Cable from the reader to the panel should be limited to 500 feet.

## LED, Beeper Connections

The Green LED and beeper will activate briefly to indicate a successful card read, otherwise the LED is normally off. The LED and beeper inputs are activated when asserted (grounded or held to logic low, below 2.5VDC) and the control cable from the reader to the panel should be limited to 500 feet. The control panel activates the beeper and red or green LED to signal the cardholder that they have been granted or denied access to the controlled door or gate.

## Hold Input

The Hold Input is a control line which when asserted would buffer one card read until the line is released, at which time the last card read would be transmitted. This input can be connected to the contact or logic output of a vehicle loop detector, so that the card reader will not accept a card unless a vehicle is present.

WIEGAND READER CONNECTIONS		
Wire Color	Function	NOTES
BLACK	GROUND (-)	
RED	9-14 VDC (+)	
BLUE	HOLD LINE	Ground to Activate
YELLOW	BUZZER	Ground to Activate
BROWN	RED LED	Ground to Activate
ORANGE	GREEN LED	Ground to Activate
WHITE	WIEGAND DATA 1	Open Collector Output
GREEN	WIEGAND DATA 0	Open Collector Output
WHT/BLK	Earth Ground	RKWL Only
GRAY	Not used	RKWL only
VIOLET	Not used	RKWL only
WHT/BRN	Not Used	RKWL Only

**Table 1 - Radio Key® Wiegand Reader Connections**

## Other Readers

Stand alone Readers, such as RK600 and RK65K do not use a standard Wiegand interface. Wiring information can be found at [www.securakey.com](http://www.securakey.com).

The RK-XRM and RK-XRS models also do not use a standard Wiegand interface. Wiring information can be found at [www.securakey.com](http://www.securakey.com).

## Using Radio Key® for Non-Access Control Applications

To use Radio Key® Readers for non-access control applications such as biometrics, time and attendance, vending, etc., the Application Provider must use the Access Control ID number as an index to a database application located on the host system. Radio Key proximity is a read-only technology which is not capable of storing user data on cards or tags.

Wiegand output readers such as RKWM, RKWS, and RKWL can be interfaced to a PC running a database application by using a data format converter, available from companies such as Cypress Computer Systems and RFIDEas Inc. Interface options include keyboard (wedge) input, a COM port, or a USB port.

RS-485 Smart Readers such as RK-XRM and RK-XRS can be interfaced with a database application by using an RS485-to-RS232 converter at the host computer, and by connecting up to 100 individually addressable readers on a multidrop network via twisted pair cabling. The RS-485 interface is slightly more complex when multiple readers are used, requiring an addressing scheme and polling of connected readers by the host.

Once this is done, the Application Provider will have an integrated offering consisting of a Radio Key® reader connected to a PC or specialized terminal, or to a device such as a printer, fuel dispenser, photocopier, vending machine, etc.

A Windows platform is not required to communicate with the Radio Key® Smart Reader – low level protocol commands can be used by microcontrollers and non-Windows software platforms. These applications can be written in C or Assembly language.



## Contact Info

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