PNAE010-CB
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SPRINGCARD K531 AND K632

Hardware and integration manual

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REVISION HISTORY

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AA	22/04/04	LBE				Initial release – Title is “antenna design”
BA	28/04/09	LSU				New SpringCard layout
CA	22/06/10	JDA				Title changed
CB	02/12/10	TGI				Change Schema Driving LEDs

TABLE OF CONTENT

1. INTRODUCTION

1.1. ABSTRACT

SpringCard **K531** and **K632** are OEM contactless couplers, ideal to bring support for RFID tags or contactless smartcard to any industrial or embedded system.

This document provides all necessary information to integrate K531 or K632 in your design.

1.2. IMPORTANT – READ ME FIRST

Both K531 and K632 need an external antenna to operate.

The antenna has to be designed carefully, depending on your own specifications (size constraints, expected operating distance) but with limited flexibility due to the requirements of the ISO standards and the EMC regulations.

SpringCard has a strong experience in antenna design. Don't hesitate to contact us for consultancy.

We also offer ready-to-use OEM couplers, featuring K531 or K632 mounted on an antenna (K531-TTL, K632-TTL, K531-232, K632-232, K531-485 and K632-485). Visit our website for detailed information.

1.3. SUPPORTED PRODUCTS

At the date of writing, this document refers to:

- SpringCard K531,
- SpringCard K632.

Please refer to the product leaflets for a detailed list of features.

1.4. AUDIENCE

This manual is designed for use by electronic hardware integrators. It assumes that the reader has expert knowledge of digital electronics.

1.5. SUPPORT AND UPDATES

Interesting related materials (product datasheets, application notes, sample software, HOWTOs and FAQs…) are available at SpringCard's web site:

www.springcard.com

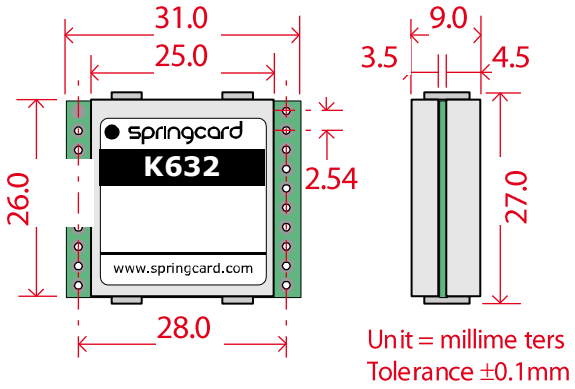
Updated versions of this document and others will be posted on this web site as soon as they are made available.

For technical support enquiries, please refer to SpringCard support page, on the web at address www.springcard.com/support .

2. HARDWARE AND PINOUT

K531 and **K632** share the same external dimensions and pinout.

2.1. DIMENSIONS



2.2. PINOUT

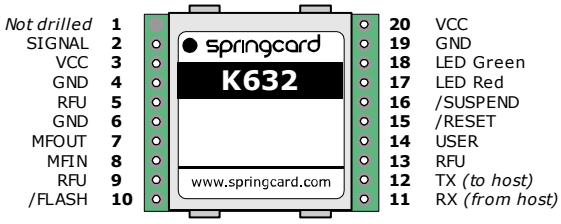


Table 1: pinout details

PIN	NAME	Type	Description	Remark
1				*Hole not drilled* *Do not connect*
2	SIGNAL	Analog	50 Ω unbalanced antenna	
3	VCC	Power	Power supply – 5V DC	
4	GND	Ground	Ground	
5	RFU			*unconnected*
6	GND	Ground	Ground	
7	MFOUT	OUT	MFOUT pin of RC chipset	*unconnected if not used*
8	MFIN	IN	MFIN pin of RC chipset	*unconnected if not used*
9	RFU			*not connected*
10	/FLASH	IN	*Firmware upgrade (active low)*	internal pull-up unconnected if not used
11	RX	IN	*Serial port – host to module*	**External pull-up required**
12	TX	OUT	*Serial port – module to host*	
13	RFU			*not connected*
14	USER	IN/OUT	*USER I/O*	
15	/RESET	IN	*Reset (active low)*	internal pull-up unconnected if not used
16	/SUSPEND	IN	*Hard power-down (active low)*	internal pull-up unconnected if not used
17	LED Red	OUT	*Red LED output*	unconnected if not used
18	LED Green	OUT	*Green LED output*	unconnected if not used
19	GND	Ground	*Ground*	
20	VCC	Power	Power supply – 5V DC	

2.3. DETAILS AND PRECAUTIONS

- **Digital input pins** (/FLASH, RX, USER when configured as input, /RESET and /SUSPEND) are TTL inputs (0-5V). They are CMOS-tolerant (0-3V).
- **Digital output pins** (TX, USER when configured as output, LED Red and LED Green) are TTL outputs (0-5V). They could drive CMOS logic as well.
- Do not connect the LED pins directly to the LEDs. Use appropriate power buffer (§ 4.3).
- Do not connect the RX/TX pins directly to an RS-232 interface. Use appropriate line buffers (§ 4.2).
- Default baudrate is 38400bps and could be switched to 115200bps by software.

3. ELECTRICAL CHARACTERISTICS

Table 2: Operating conditions

SYMBOL	Parameter	Condition	Min	Typ	Max	Unit
VCC	Supply voltage		4.5	5.0	5.5	V
ICC	Power supply current	Hard power down			6	mA
		RF field OFF		30	35	
		RF field ON[1]		150	250	

Table 3: I/Os characteristics

SYMBOL	Parameter	Condition	Min	Typ	Max	Unit
V_{OH}	Output "High" voltage (TX, LED Red, LED Green, USER configured as output)	I_{OH} = -1mA	VCC -0.6		VCC	V
V_{OL}	Output "Low" voltage (TX, LED Red, LED Green, USER configured as output)	I_{OL} = 1mA			0.6	V
I_{IH}	Input "High" current (RX, /SUSPEND, USER configured as input)	V_I = 3V			4	µA
I_{IL}	Input "Low" current (RX, /SUSPEND, USER configured as input)	V_I = 0V			-4	µA

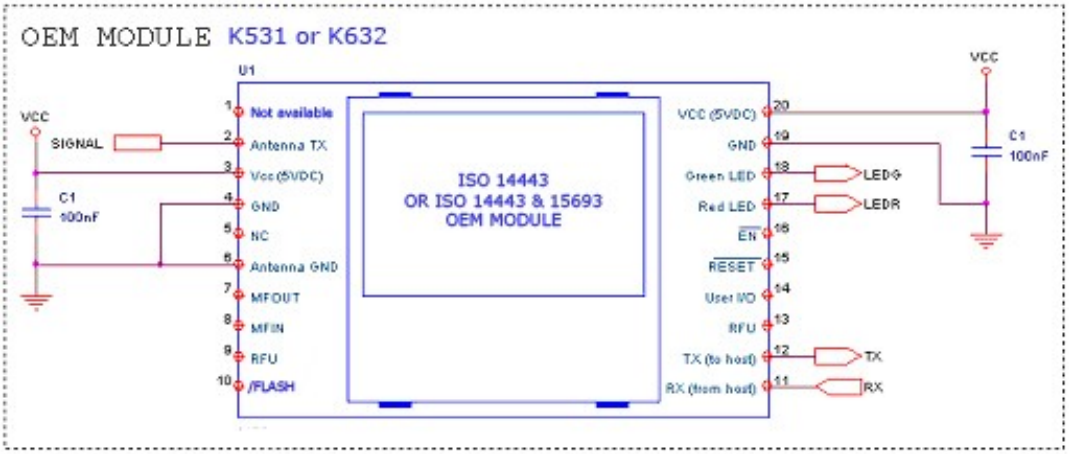
Table 4: Limiting values

SYMBOL	Parameter	Limits	Unit
VCC	Supply voltage	-0.3 to 6.0	V
$T_{OPERATION}$	Operating temperature	-20 to +70	°C
$T_{STORAGE}$	Storage temperature	-40 to +85	°C
$I_{OH(PEAK)}$	Peak output "High" current (TX, LED Red, LED Green, USER configured as output)	-10	mA
$I_{OH(AVG)}$	Average output "High" current (TX, LED Red, LED Green, USER configured as output)	-5	mA
$I_{OL(PEAK)}$	Peak output "Low" current (TX, LED Red, LED Green, USER configured as output)	10	mA
$I_{OL(AVG)}$	Average output "Low" current (TX, LED Red, LED Green, USER configured as output)	5	mA

[1] The antenna has a strong impact on the current consumed by the module. Typical value is observed with SpringCard's 69x45mm antenna correctly tuned.

4. INTEGRATION GUIDE

4.1. VCC AND GND

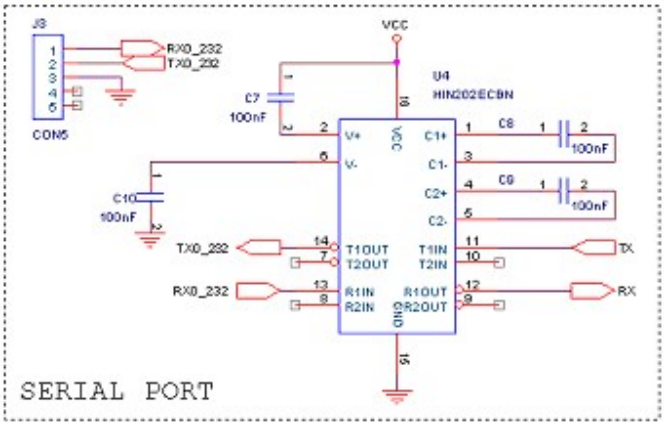


- Decoupling capacitors shall be placed as close as possible to pins 3,4,6 and, 20,19 respectively.
- Unused pins shall be left unconnected.

4.2. ADDING A RS-232 LINE DRIVER

K531 and K632's RX and TX pins provide a serial interface at TTL level (CMOS tolerant). To connect to a standard RS-232 interface (i.e. the comm. port of a PC), a line driver has to be added.

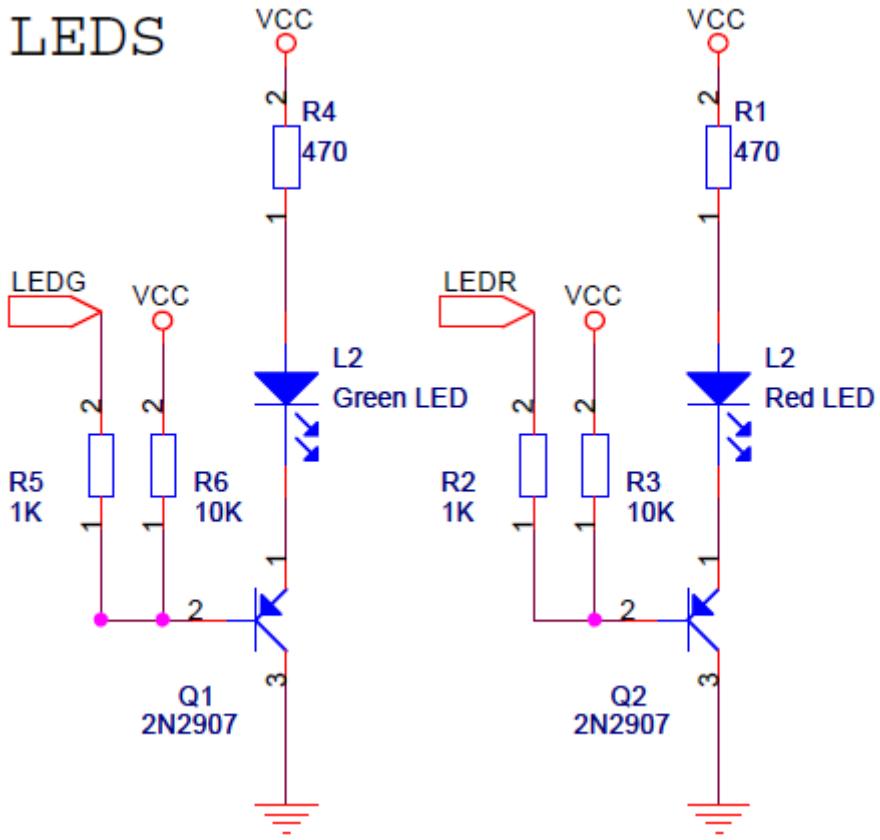
Adapt this example to the line driver component you've chosen.



4.3. DRIVING LEDS

K531 and K632 feature 2 LED outputs, named Red and Green. Optionally the USER pin may be used as 3rd LED output (Yellow or Blue for instance).

Use bipolar transistors to drive the LEDs, as follow:



4.4. RESET

When /RESET is set LOW, the module's CPU stops. When /RESET is set HIGH again, firmware execution restarts.

Note that the /RESET pin has no effect on the RF front-end (NXP RC531 or RC632). If the RF field was ON before reset, it remains ON until the firmware instructs it to go OFF, or the module is powered down.

Depending on the firmware release, the module takes 10 to 50ms to be ready after a reset.

The module is ready as soon as it sends its identifier (either "K531" or "K632" on the serial line).

4.5. HARD-POWER DOWN

When /SUSPEND state is set LOW, the module stops its RF field, deactivate its RF front-end (NXP RC531 or RC632), and stops its clock to limit power consumption to its minimum.

When /SUSPEND state is set HIGH again, firmware execution resumes after 1 to 10ms.

NB: this feature is implemented only in firmware version ≥ 1.54.

4.6. FIRMWARE UPGRADE

Hold to /FLASH pin to LOW level and RESET the module to enter FIRMWARE UPGRADE mode.

The FIRMWARE UPGRADE is made through the serial line, using to the CPU's integrated bootloader. To flash the module, use RENESAS FLASH DEVELOPMENT TOOLKIT (FDT) version ≥ 4.04.

- **K531:** CPU is Renesas R8C/25 with a 32kB flash. Configure your FDT project to use **R5F21256** kernel.
- **K632:** CPU is Renesas R8C/25 with a 64kB flash. Configure your FDT project to use **R5F21258** kernel.

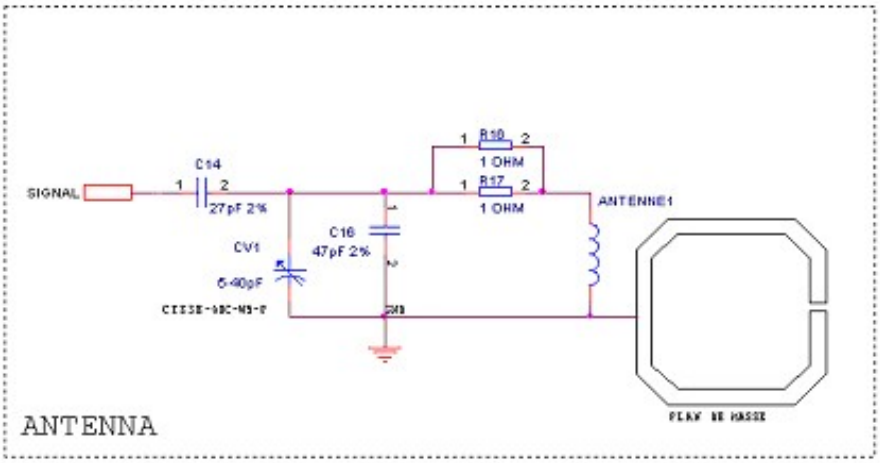
NB: it is not recommended to upgrade the firmware while the RF field is switched ON. Before entering FIRMWARE UPGRADE mode, please either invoke firmware's SET RF FIELD OFF command or set the /SUSPEND pin LOW.

5. ANTENNA

5.1. ANTENNA MATCHING CIRCUIT

The K531 and K632's RF stage is designed to drive directly an unbalanced antenna.

The RF stage has a 50Ω matching circuit. Therefore, the antenna must be matched to 50Ω too. Here's the typical antenna matching circuit:



- Adjustable capacitor CV1 is recommended to adapt the antenna's tuning to the actual characteristics of the PCB, and to the environment.

5.2. DESIGNING YOUR OWN ANTENNA

NXP (formerly Philips Semiconductors), the manufacturer of the chipsets used in K531 and K632, has written application notes on the subject.

It would be useless to rewrite those documents that are complete, comprehensive, and available freely.

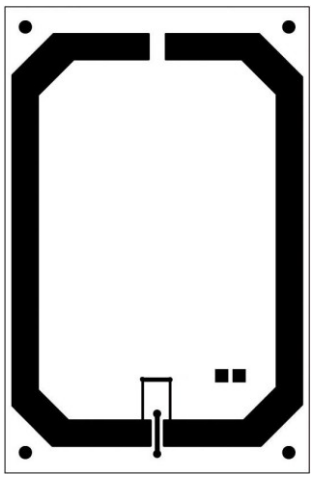
- NXP AN 077925 : Directly matched antenna design
  http://www.nxp.com/documents/application_note/077925.pdf
- NXP AN 78010 : 13.56MHz RFID proximity antennas
  http://www.nxp.com/documents/application_note/78010.pdf

5.3. TYPICAL ANTENNA SHAPES

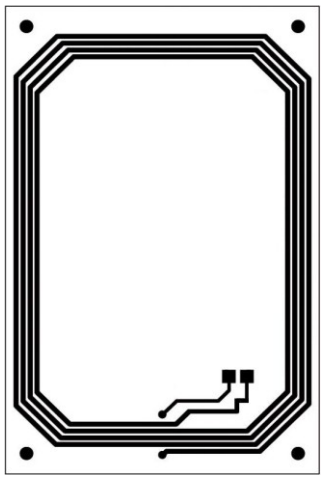
The antennas depicted here are used in SpringCard's products. Don't hesitate to ask us for schematics and PCB files if you intend to copy them into your own design.

5.3.1. Example 1: 69 x 45mm PCB

This is the antenna designed for our "OEM modules with antenna" family (K531-TTL, K632-TTL, K531-232, K632-232, K531-485 and K632-485). It is also CrazyWriter's default antenna.



Front

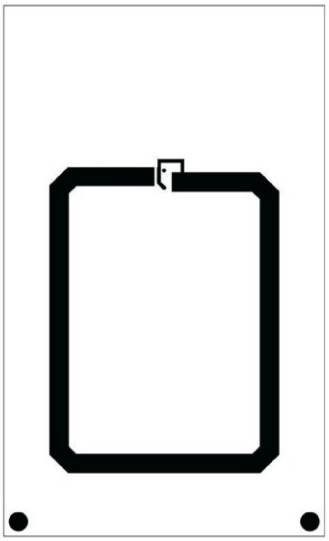


Back

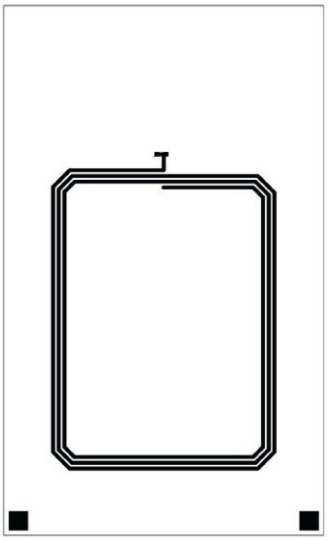
NB: PCB thickness = 1.6mm

5.3.2. Example 2: 139 x 84mm PCB

This is the antenna designed for the CSB4 family.



Front



Back

NB: PCB thickness = 1.6mm

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