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SPRINGCARD H632

Integration guide

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1. INTRODUCTION

1.1. ABSTRACT

SpringCard H632 is an OEM contactless coupler, ideal to bring support for contactless smartcards, RFID tags or NFC objects to any industrial or embedded system.

SpringCard H632 features both serial and USB (device) interface. The module also includes a contact smartcard reader, able to interface directly with one card (or a SIM or SAM). Only a few external components are needed to interface with up to 5 cards in a minimal footprint.

This document provides all necessary information to integrate **H632** in your design and take benefit of all its features.

1.2. IMPORTANT – READ ME FIRST

H632 needs an external antenna to behave as a contactless reader.

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 engineers have a strong experience in antenna design. Do not hesitate to contact us for consultancy every time you need a custom design.

We also offer **ready-to-use couplers**, featuring H632 mounted on an antenna (H632-USB, CrazyWriter-HSB, CSB-HSP).

Please visit www.springcard.com/products for an up-to-date list.

1.3. AUDIENCE

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

1.4. SUPPORT AND UPDATES

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

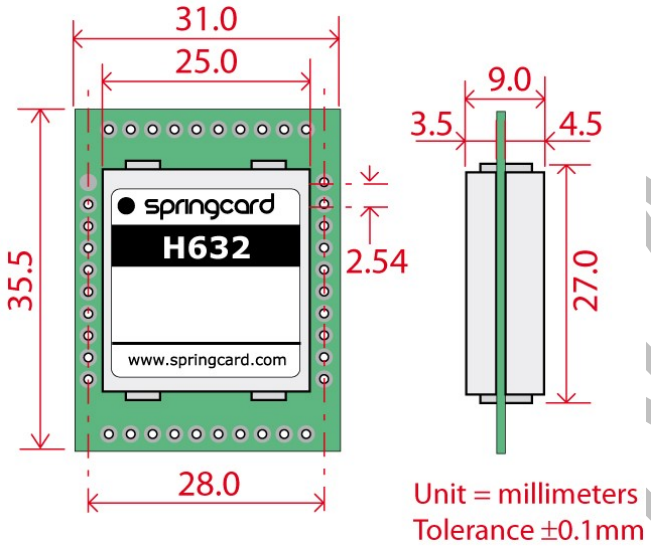
www.springcard.com

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

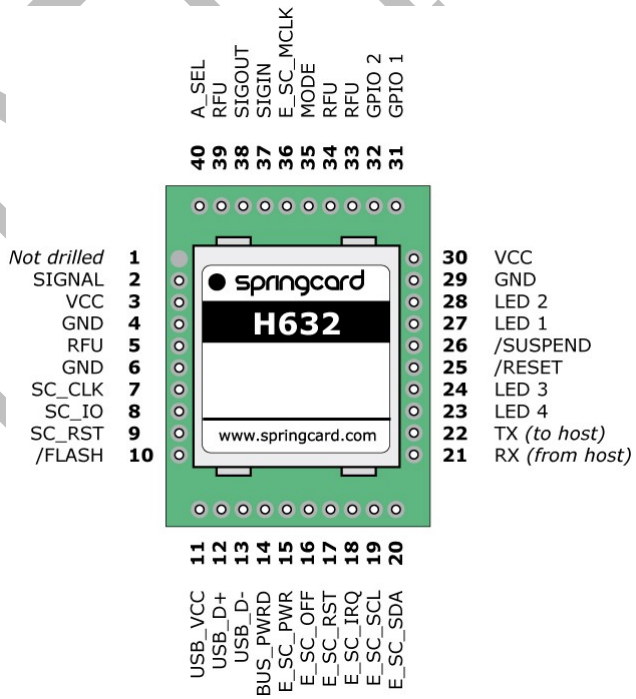
For technical support enquiries, please refer to SpringCard support page, on the web at address www.springcard.com/support .

2. HARDWARE AND PINOUT[1]

2.1. DIMENSIONS



2.2. PINOUT



[1] Note that in most situations H632 could be used as drop-in replacement for K531 and K632.

Table 1: pinout details

PIN	NAME	Type	Description	Remark	§
1				**Hole not drilled**	
2	SIGNAL	Analog	50Ω unbalanced antenna		4.6
3	VCC	Power	Power supply – 5V DC		4.1.1
4	GND	Ground	Ground		
5	RFU			Leave unconnected	
6	GND	Ground	Ground		
7	SC_CLK	OUT	Smartcard clock		4.7/4.8
8	SC_IO	IN/OUT	Smartcard I/O		4.7/4.8
9	SC_RST	OUT	Smartcard reset		4.7/4.8
10	/FLASH	IN	Firmware upgrade (active low)	Internal pull-up	4.1.5
11	USB_VCC	Power	Bus power supply for USB link		4.2
12	USB_D+	IN/OUT	USB D+		4.2
13	USB_D-	IN/OUT	USB D-		4.2
14	USB_PWRD	IN	Enable power by USB link		4.1.1
15	E_SC_PE	OUT	Ext. smartcard driver PWR EN		4.8
16	E_SC_BP	OUT	Ext. smartcard driver BYPASS		4.8
17	/E_SC_RST	OUT	Ext. smartcard driver /RESET		4.8
18	/E_SC_INT	IN	Ext. smartcard driver /INT		4.8
19	E_SC_SCL	IN/OUT	Ext. smartcard driver SCL		4.8
20	E_SC_SDA	IN/OUT	Ext. smartcard driver SDA		4.8
21	RX	IN	Serial port – host to H632	**External pull-up required**	4.3
22	TX	OUT	Serial port – H632 to host		4.3
23	/LED4	OUT	LED 4		4.4
24	/LED3	OUT	LED 3	*YELLOW or BLUE*	4.4
25	/RESET	IN	H632 reset (active low)	Internal pull-up	4.1.2
26	/SUSPEND	IN	H632 low power mode (active low)	Internal pull-up	4.1.3
27	/LED1	OUT	LED 1 / Red LED	*RED*	4.4
28	/LED2	OUT	LED 2 / Green LED	*GREEN*	4.4
29	GND	Ground	*Ground*		
30	VCC	Power	Power supply – 5V DC		4.1.1
31	GPIO1	IN/OUT			4.5
32	GPIO2	IN/OUT			4.5
33	GPIO3	IN/OUT			4.5
34	GPIO4	IN/OUT			4.5
35	MODE	IN	Firmware operating mode	Internal pull-up	4.1.4

Table continuing next page

Table 1 (continuing)

PIN	NAME	Type	Description	Remark	§
36	M_CLOCK	OUT	12MHz output clock		4.8
37	SIGIN	IN	RC632's SIGIN/MFIN		
38	SIGOUT	OUT	RC632's SIGOUT/MFOUT		
39	RFU			Leave unconnected	
40	RFU			Leave unconnected	

3. ELECTRICAL CHARACTERISTICS

3.1. ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed under 'Absolute Maximum Ratings' may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these conditions is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

SYMBOL	Parameter	Min	Max	Unit
VCC_{ABS}	DC supply voltage with respect to ground	-0.3	6.0	V
$V_{IN,ABS}$	Voltage to any pin with respect to ground	-0.3	VCC+0.3	V
$I_{OUT,ABS}$	Total DC output current on all I/O pins		200	mA
$I_{SIGNAL\ PEAK}$	Peak current delivered by the SIGNAL pin		200	mA
$T_{STORAGE}$	Storage temperature	-20	+70	°C

3.2. OPERATING CONDITION RANGE

SYMBOL	Parameter	Condition	Min	Typ	Max	Unit
$T_{OPERATION}$	Operating temperature		-20	+25	+70	°C
VCC	Supply voltage		4.5	5.0	5.5	V
ICC	Power supply current	Soft power down			6	mA
		RF field OFF		30	35	
		RF field ON[2], no smartcard[3]		150	250	

3.3. INPUT PIN CHARACTERISTICS

Pins RX, /SUSPEND, /RESET, /FLASH and /GPIOx (when configured as input) have TTL input characteristics.

SYMBOL	Parameter	Min	Max	Unit
V_{IL}	LOW-level going threshold		0.8	V
V_{IH}	HIGH-level going threshold	2.0		V
I_{LEAK}	Input leakage current		4	µA

[2] The antenna has a strong impact on the current consumed by the module. Typical value is observed with SpringCard's reference antenna (§ 4.6.2) correctly tuned.

[3] A SAM smartcard directly connected to the H632 (§ 4.7) may sink up to 60mA. When an external smartcard driver is used (§ 4.8), the power supply shall be able to deliver 60mA per slot.

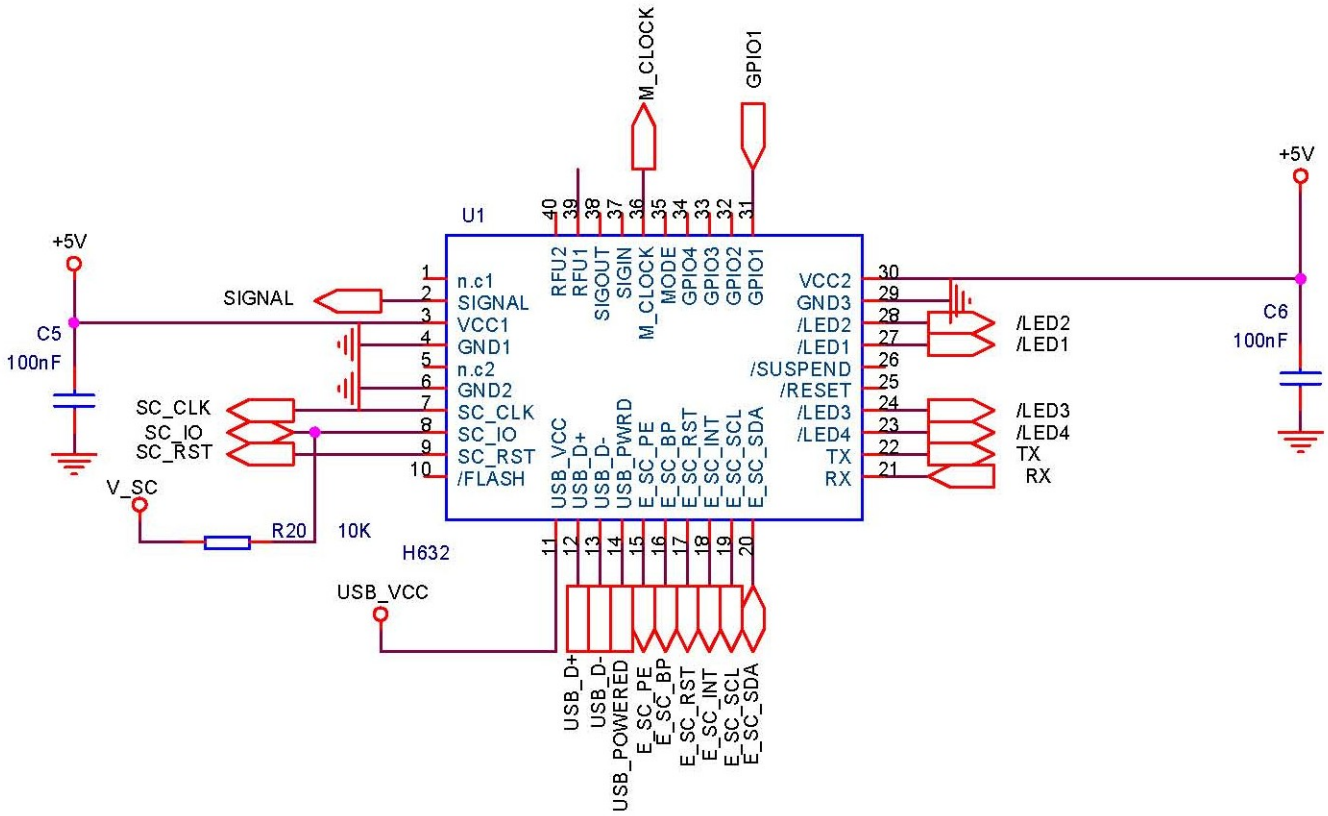
3.4. OUTPUT PIN CHARACTERISTICS

Pins TX, /LEDx, and /GPIOx (when configured as output) have TTL output characteristics.

SYMBOL	Parameter	Min	Max	Unit
V_{OL}	Output LOW-level		0.4	V
V_{OH}	Output HIGH-level	2.4		V
I_O	Output current source or sink		4	mA

4. INTEGRATION GUIDE

4.1. GENERAL



4.1.1. Power supply

Connect both VCC pins (#3 and #30) to 5V DC supply.

100nF decoupling capacitors (C5 and C6 on reference schematics) shall be placed as close as possible to pins #3 and #4, #30 and #29, respectively.

a. No USB, or USB plus external power source

- Leave pin USB_PWRD (#14) unconnected, or tie it to HIGH level.

b. USB - Bus powered operation

- Tie pin USB_PWRD (#14) to LOW level,
- Connect VBUS to USB_VCC and to VCC as depicted in § 4.2,

Care must be taken that all the external components SHALL NOT draw more than 5mA until the device the host has allowed it to power up fully. The module

sets its pin E_SC_PE (#15) to HIGH when this is the case (and back to LOW when the host driver puts it in suspend mode).

In any case, the external components SHALL NOT draw more than 150mA from the USB power line (the H632 asks for 400mA in its USB descriptor, and needs up to 250mA for itself).

4.1.2. Reset

H632 has its own reset supervisor. The /RESET pin (#25) shall be used only if a manual reset is needed. Otherwise, cycling the power is enough to ensure a proper reset of the module.

When /RESET is set LOW, the module's CPU stops. When /RESET is set HIGH again, firmware execution restarts. Depending on the firmware release and the activated options, the module takes 10 to 50ms to be ready after a reset. The module is ready as soon as it sends its identifier "H632" on the serial line or is reported "hot plugged" on the USB interface.

Note that the /RESET pin has no effect on the RF front-end. 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.

4.1.3. Suspend mode (soft power down)

The /SUSPEND pin (#26) is intended to put the module in soft power down mode, to limit power consumption to a minimum.

When /SUSPEND is set LOW, the RF field is shut down, the RF front-end and the smartcard interfaces are powered down and the internal clock slows down. The module stops listening to the serial interface.

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

DO NOT USE this feature when the module operates as an USB device. Suspend mode shall be only driven by the host's USB driver in this case.

4.1.4. Firmware operating mode

The /MODE pin (#35) is dedicated to select the operating mode of the firmware. Every standard firmware behaves as follow:

- When /MODE is HIGH (or left unconnected), firmware runs in CCID mode (PC/SC reader),
- When /MODE is LOW, firmware runs in legacy mode. This is deprecated and shall not be used anymore.

For the other (non-standard) firmwares, please refer to the actual documentation of the firmware or final product to know the role of the /MODE pin.

4.1.5. Firmware upgrade

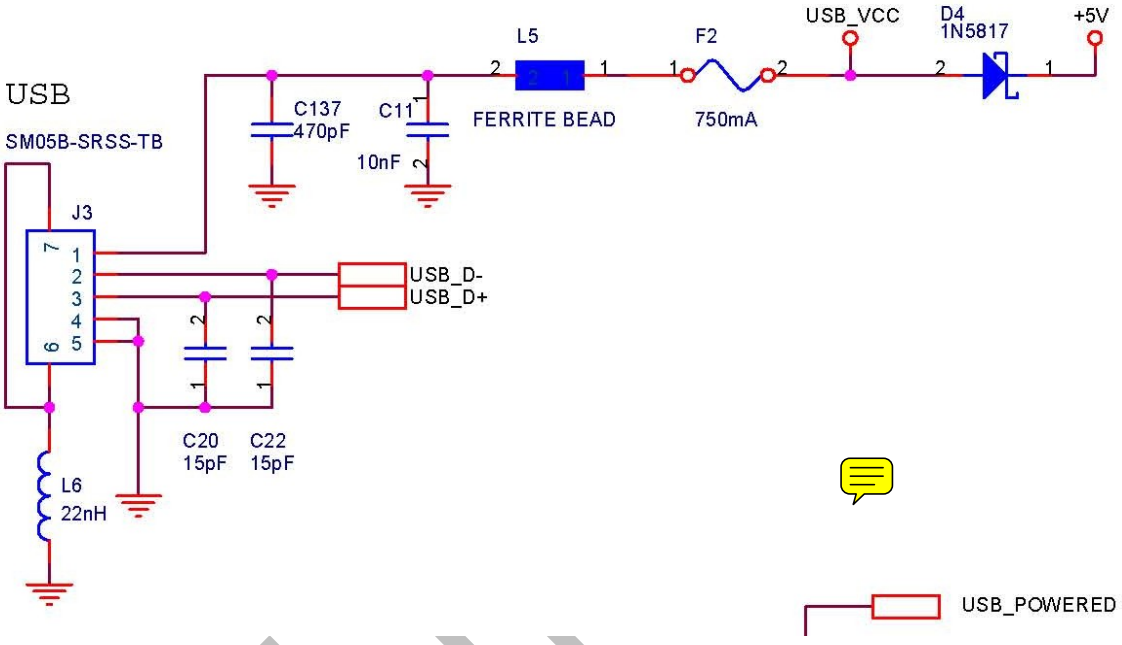
Tie to /FLASH pin (#10) is intended to put the module in firmware upgrade mode. Set /FLASH to LOW and reset the module (or cycle power) to enter this mode.

The firmware upgrade is made through the USB interface. Please refer to the application note "H632 family firmware upgrade procedure".

NOTE: DO NOT try to upgrade the firmware while the RF field is switched ON and the smartcard interface is running. To enter firmware upgrade mode safely, please either cycle power, or switch RF field OFF and disable the smartcard interface by a software command, or tie the /SUSPEND pin LOW before resetting the module.

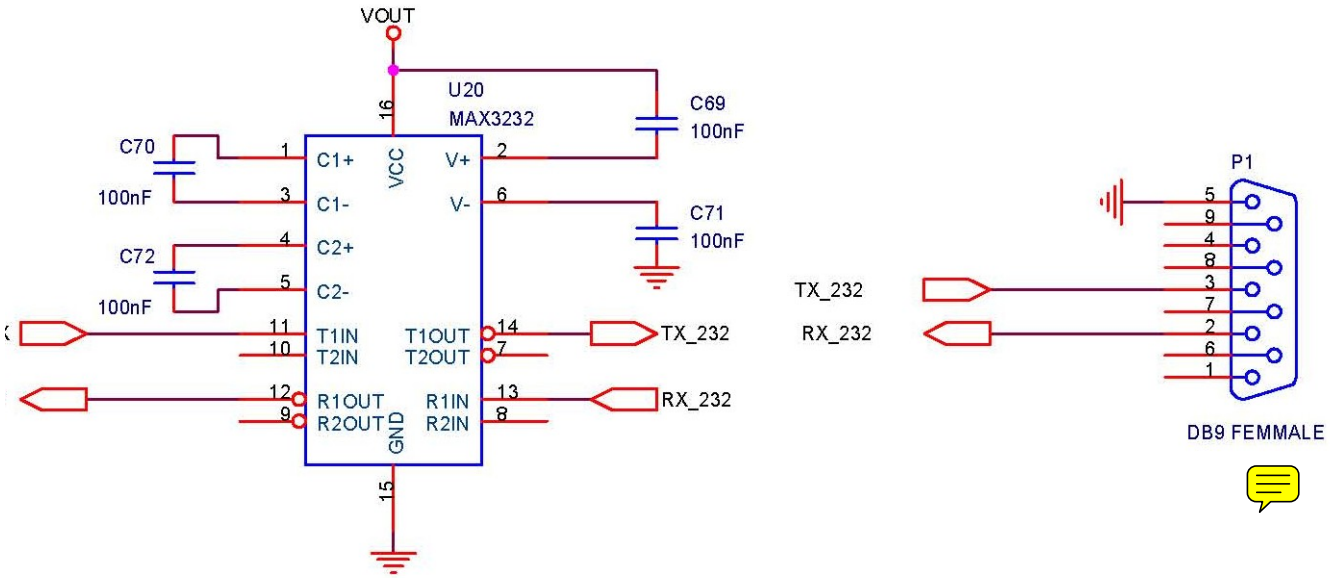
4.2. USB INTERFACE

H632 features a USB 2.0 device interface. Observe the following schematic to implement this interface according to USB hardware specifications.



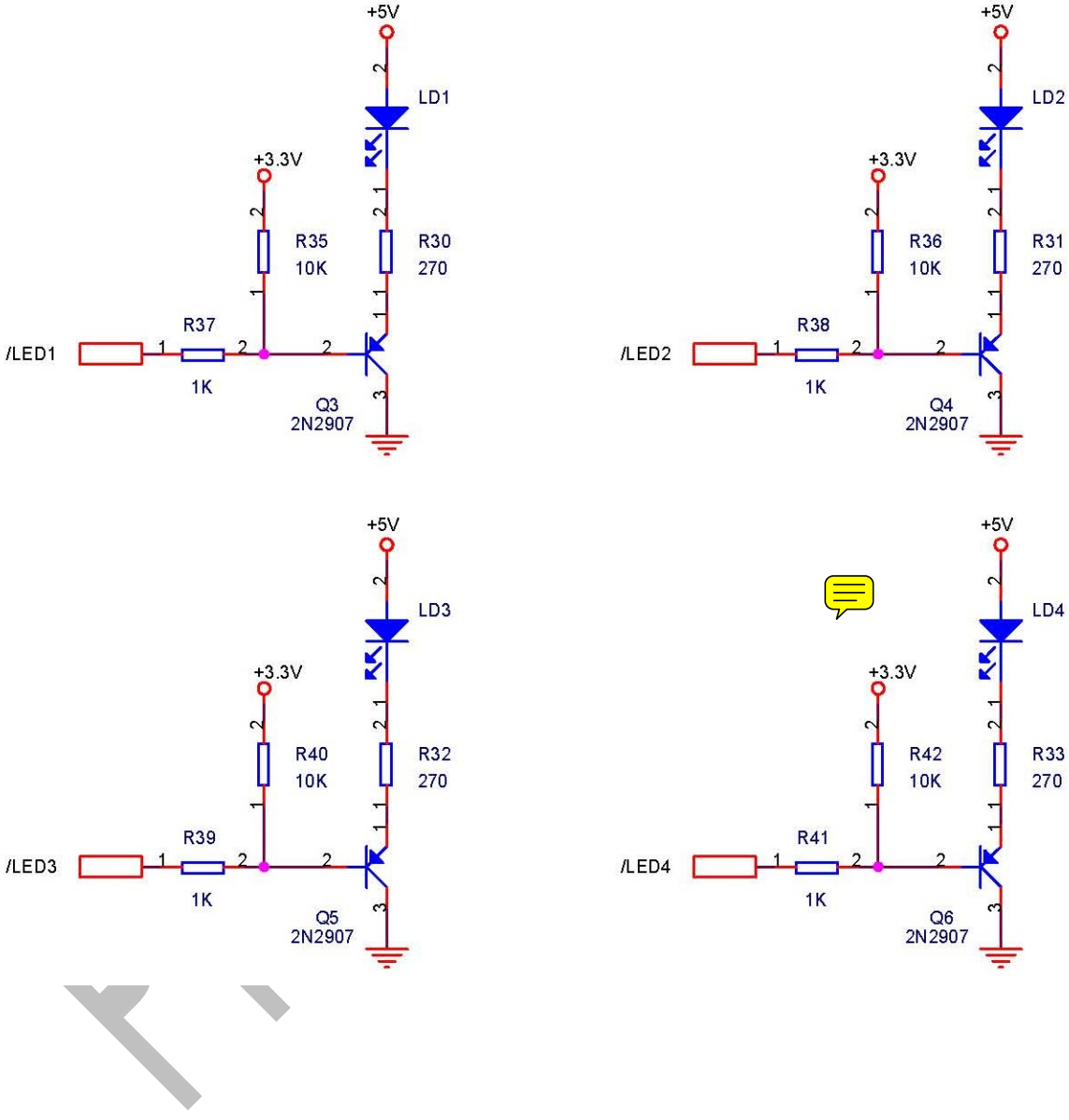
4.3. SERIAL INTERFACE

H632 features a serial communication interface at TTL-level (CMOS tolerant). Observe the following schematic to implement this interface according to RS-232 specifications (+12V/-12V, DB9 plug).



4.4. LED DRIVERS

H632 LED output lines are active LOW and must be buffered to drive the LEDs. Use bipolar transistors, as follow:



4.5. GPIOs

4.5.1. Using a GPIO as input

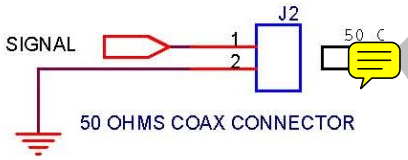
4.5.2. Using a GPIO as output

4.6. ANTENNA

4.6.1. H632 signal pin

H632's SIGNAL pin (#2) is made to drive directly a **50Ω-matched, unbalanced antenna**. No external component is needed.

The antenna shall be connected to the module through a 50Ω coaxial cable (max recommended distance: 1m). Therefore the SIGNAL pin shall be linked to a coaxial connector with the minimum distance.



When the distance between the module and the antenna is really short (< 50mm), a twisted pair or copper lines on the PCB could be used instead of the coaxial cable.

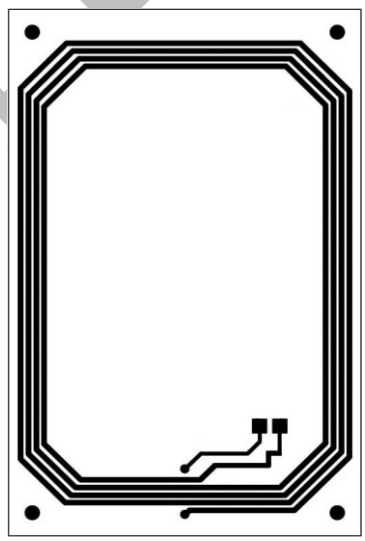
4.6.2. Reference antenna

We provide here as a reference the schematics and layout of CrazyWriter's standard antenna.

This antenna fits a 69 x 45 mm PCB, 1.6mm thick, having 2 layers.

a. Antenna loops

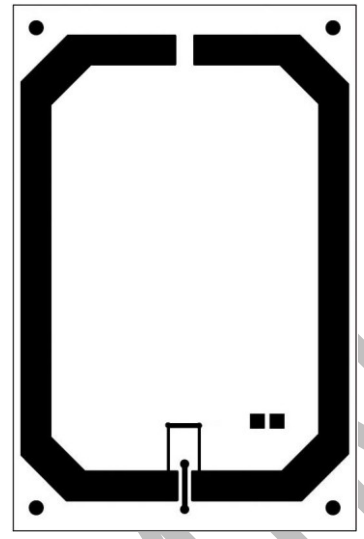
The antenna shall have an inductance between 300nH and 1.5µH. This gives us 4 loops in the available surface.

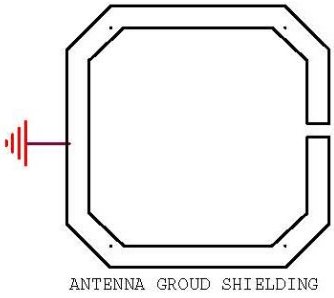


b. Shielding

To comply with EMC regulations, the antenna shall be shielded to limit the radiated E field (only H field is useful in 'near field' communication).

The shield is a large open loop, tied to Ground, as follow:

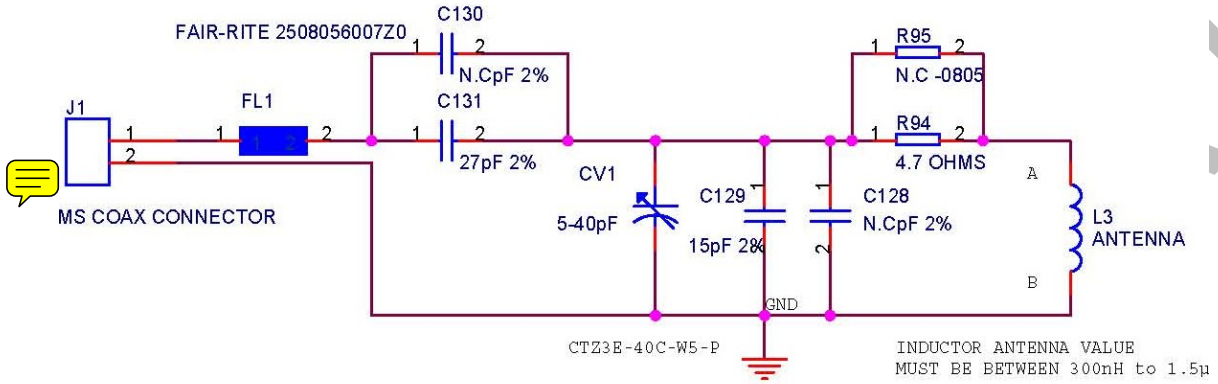




c. Matching and tuning circuit

This circuit has got 2 roles:

- **Tune up** the antenna as a band-pass filter centred on 13.56MHz (C129, C128, CV1) with a **quality factor** (Q) of approx. 40 (R94, R95),
- **Match** the antenna to 50Ω (C129, C130), so it can't be connected to H632's SIGNAL pin either directly or through a coaxial cable.



4.6.3. Designing a custom antenna

Designing an antenna for 13.56MHz RFID or NFC applications requires some kind of expertise and can't be improvised. A poorly designed antenna may be the cause of a too short operating distance, 'holes' in the operating volume, excessive power consumption and overheating, damages in the module's output stage, non-compliance with ISO standards and EMC regulations.

As reference documentations, please refer to NXP (formerly Philips Semiconductors) application notes on the subject:

- **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

The RF chipset in H632 is NXP RC632. Please take in account RC632's limiting characteristics, especially the maximum output current on the antenna stage that is **200mA PEAK**[4].

SpringCard engineers have a strong experience in antenna design. Do not hesitate to contact us for consultancy every time you need a custom design.

[4] 200mA peak on the square signal delivered by RC632's TX1 and TX2 pins.

4.7. SINGLE SAM INTERFACE

H632 is able to manage 1 SAM without the need of any external component.

4.8. SMARTCARD AND SAM INTERFACES

H632 is able to manage up to 5 cards through an external smartcard driver, component AT83C26 from Inside Secure (formerly from Atmel). In these reference schematics we implement one smartcard slot and four SAM slots (numbered SAM2 to SAM5), but you may as well have two smartcard slots and three SAM slots.

Please refer to **Inside Secure's AT83C26 technical datasheet** for a complete understanding of the design:

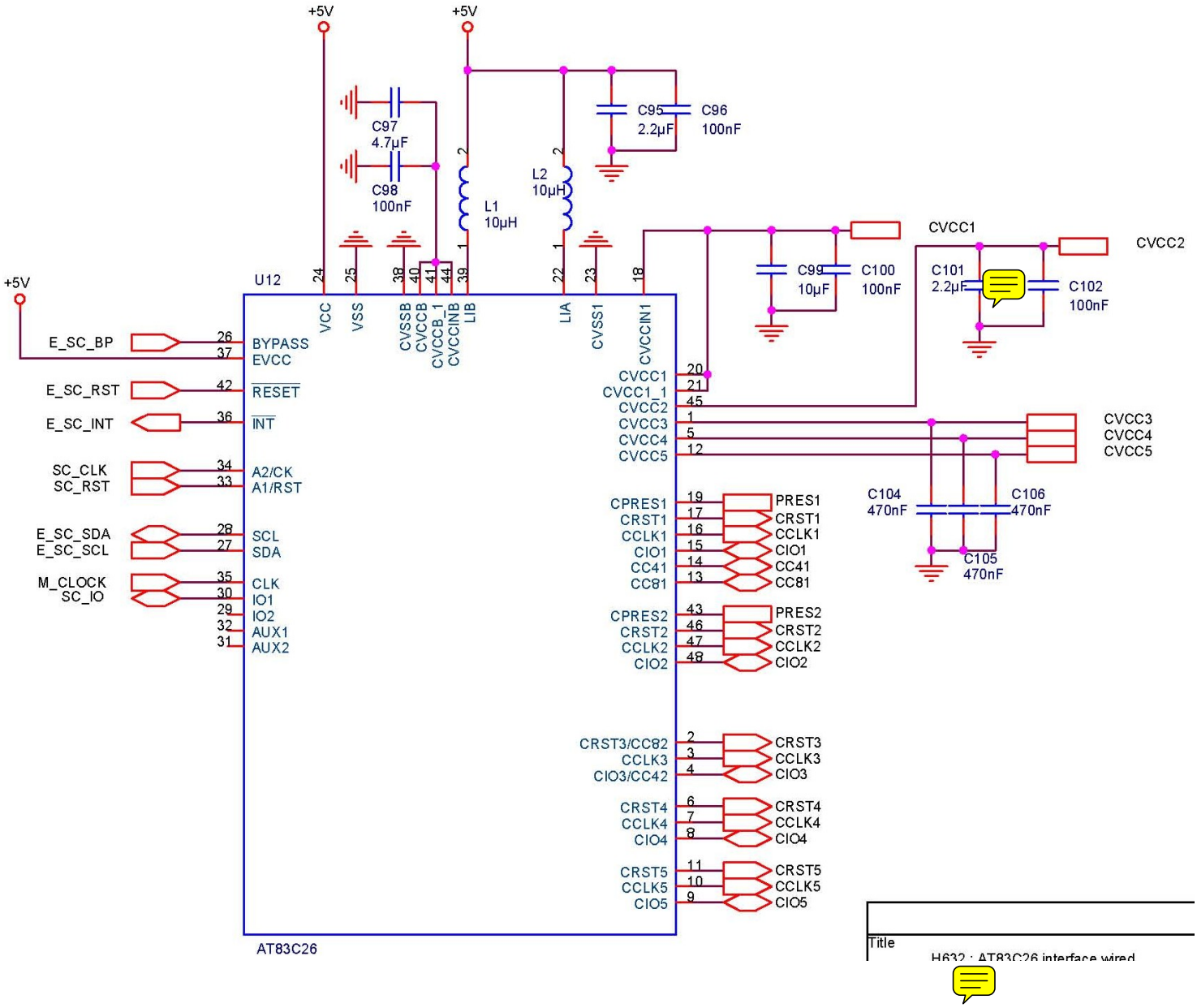
http://www.insidesecure.com/eng/content/download/974/9263/version/2/file/TPR0508A+-+AT83C26_Datasheet.pdf

4.8.1. Smartcard driver

AT83C26's 5V power supply is driven by H632 E_SC_PE pin (#15).

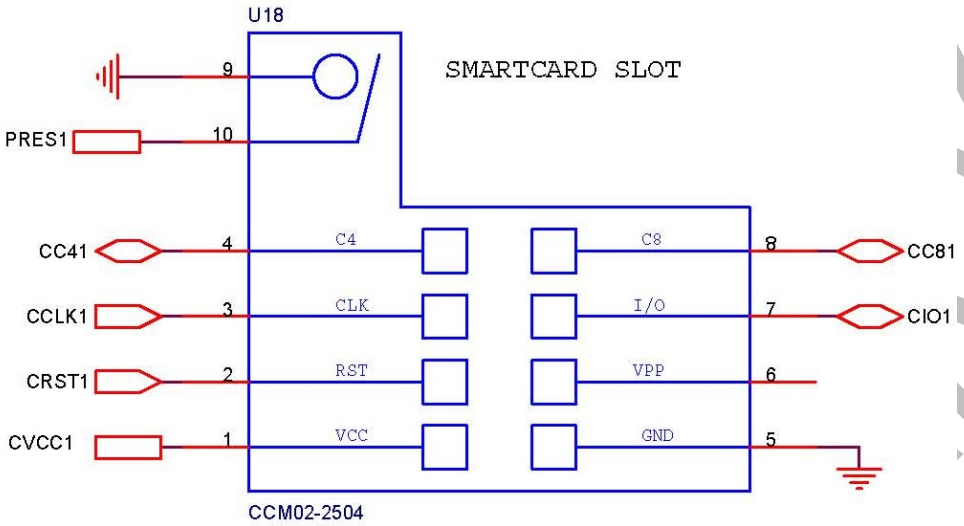
Decoupling and filtering capacitors (C95, C96, C97, C98) and inductors (L1, L2) shall be placed as close as possible to the component's pins.

Smartcard power lines (CVCCx) need decoupling capacitors close to the component (C99, C100, C101, C102, C104, C105, C106) and also close to the connector (see next pages).

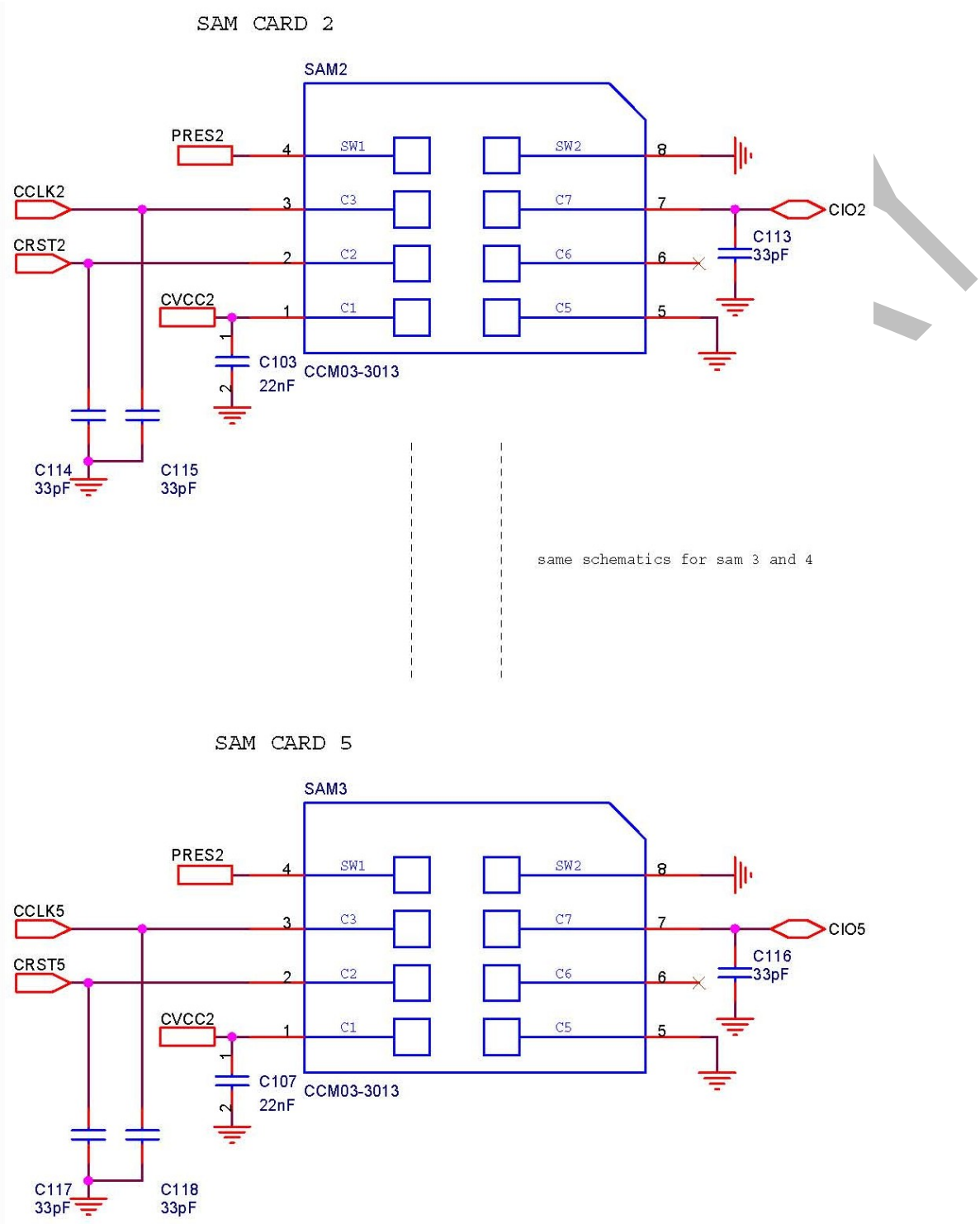


4.8.2. Smartcard slot

The card presence switch (line PRES1) is mandatory for a correct operation.

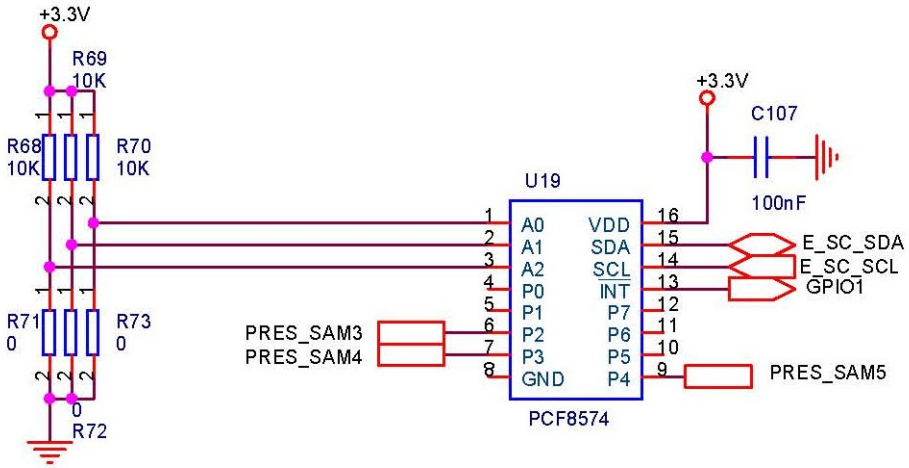


4.8.3. SAM slots



1st SAM slot (SAM CARD 2) has its own card presence input within the AT83C26 (PRES2). Presence of the card in the other slots (SAM CARD 3 to SAM CARD 5) is monitored through a PCF8574 component (I2C I/O interface).

Note that the card presence switches are optional for the SAM slots. If your connectors don't feature the presence switches, tie the corresponding lines (PRES2 to PRES5) to ground, and do not install the PCF8574.



5. REFERENCE B.O.M.

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