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SPRINGCARD H663

Hardware integration guide

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Abstract			

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Revision History

Ver.	Date	Author	Valid. by		Approv. by	Details
			Tech.	Qual.		
AA	09/11/12	JDA				First draft
AB	05/02/13	JCH				Added schematics
AC	27/06/13	JDA				Corrected a few typos, removed 'preliminary' watermark
AD	26/08/14	JDA				Added the order codes

Contents

1. Introduction

1.1. Abstract

SpringCard H663 is a PC/SC RFID and NFC OEM module, featuring 0 to 5 optional T=0/T=1 interfaces for contact smartcards or SIM/SAM. The **H663** OEM module is ideal for integration in any industrial or embedded system.

This document provides all necessary information to integrate the **H663** OEM module in your design and take benefit from all its features.

*The **H663** OEM module needs an external antenna to work as a contactless (RFID / NFC) coupler.*

1.2. Product identification

1.2.1. Hardware

2 hardware versions of the **H663** OEM module exist:

- **H663A** features a 50Ω-matched unbalanced (asymmetrical) output, optimized to drive a **50Ω-matched unbalanced antenna**. The connexion between the module and the antenna shall use a **50Ω coaxial cable**, up to 2m. For a distance shorter than 25cm, a twisted pair may be used instead of the coaxial cable.
- **H663S** ' output is balanced (symmetrical) so it could drive a **directly-matched, balanced antenna**. The distance between the module and the antenna shall not exceed 20cm.

1.2.2. Smartcard support

There are 2 pricing options for both **H663A** and **H663S**, depending whether the smartcard/SAM feature (ISO 7816 interface) will be used or not:

- **H663A_** and **H663S_** have no smartcard/SAM support,
- **H663AC** and **H663SC** provides support for smartcard/SAM.

1.3. Product list

Product name	Order code	Description
H663S	SC14182	Contactless PC/SC OEM module for balanced antenna
H663SC	SC14183	Contact & contactless PC/SC OEM module for balanced antenna
H663A	SC14184	Contactless PC/SC OEM module for unbalanced antenna
H663AC	SC14185	Contact & contactless PC/SC OEM module for unbalanced antenna

1.4. Related documents

Editor	Doc #	Description
SpringCard	PMD2271	H663 Group – Developer's reference manual

1.5. Important – read me first

1.5.1. Antenna design

The **H663** OEM module needs an external antenna to work as a contactless (RFID / NFC) coupler. The antenna has to be designed carefully for the target module (asymmetrical for **H663A**, symmetrical for **H663S**) and depending on your own specifications (size constraints, expected operating distance), but flexibility is limited to some extent 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 consult us any time you need a custom design.

We also offer **ready-to-use couplers**, featuring the **H663** module mounted on an antenna, with or without a shell (**H663-USB**, **CrazyWriter HSP**, **TwistyWriter HSP**, **CSB HSP, CSB HSP LT**).
Please visit www.springcard.com/products for an up-to-date list.

1.5.2. Smartcard support

The **H663AC** and **H663SC** need a few external components to drive a ID-1 smartcard slot and up to 4 SAM slots (Inside Secure AT83C26, 24MHz quartz and a few passive components).

Special care must be taken when designing the layout and PCB so that clock and I/O lines will not radiate unwanted frequencies.

SpringCard engineers have a strong experience in PCB design. Do not hesitate to consult us any time you need a custom design.

We also offer **ready-to-use smartcard couplers**, featuring the **H663** and the smartcard interfaces, with or without a shell (**CrazyWriter HSP**, **CSB HSP**).
Please visit www.springcard.com/products for an up-to-date list.

1.6. Audience

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

1.7. Support and updates

Related documentation (e.g. product datasheets, application notes, sample software, HOWTOs and FAQs…) is available at SpringCard's web site:

www.springcard.com

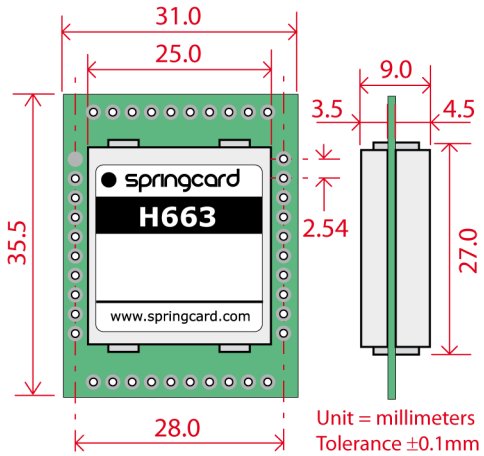
Updated versions of this document and others are posted on this web site as soon as they are available.

For technical support enquiries, please refer to SpringCard support page, on the web at

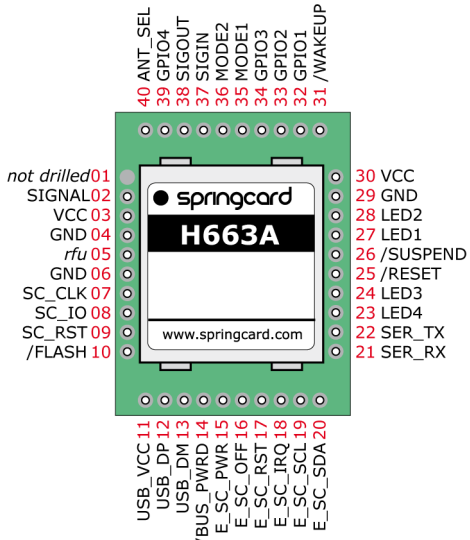
www.springcard.com/support

2. Hardware and pinout – H663A, H663AC[1]

2.1. Dimensions



2.2. Pinout



[1] Note that in a few situations, H663A/H663AC could be used as drop-in replacement for K531 or K632.

Table 1: pinout details for H663A / H663AC

PIN	NAME	Type	Description	Remark	See §
1				**Hole not drilled**	
2	SIGNAL	Analog	50Ω unbalanced antenna		6.1
3	VCC	Power	Power supply		5.1.1
4	GND	Ground	Ground		
5	3V3	Power	3,3V Power supply	Power Output 100mA Max	
6	GND	Ground	Ground		
7	SC_CLK	OUT	Smartcard clock		8.2.1/8.3.1
8	SC_IO	IN/OUT	Smartcard I/O		8.2.1/8.3.1
9	SC_RST	OUT	Smartcard reset		8.2.1/8.3.1
10	/FLASH	IN	Firmware upgrade	Internal pull-up	5.1.5
11	USB_VCC	Power	Bus power supply for USB link		5.1.1/5.2
12	USB_DP	IN/OUT	USB D+		5.2
13	USB_DM	IN/OUT	USB D-		5.2
14	/USB_PWRD	IN	H663 is powered by the bus		5.2
15	/E_SC_PWR	OUT	Ext. smartcard driver power enable		8.3.1
16	E_SC_OFF	OUT	Ext. smartcard driver bypass mode		8.3.1
17	/E_SC_RST	IN/OUT	Ext. smartcard driver reset		8.2.1/8.3.1
18	/E_SC_IRQ	IN	Ext. smartcard driver interrupt		8.3.1
19	E_SC_SCL	IN/OUT	Ext. smartcard driver I^2C SCL		8.3.1
20	E_SC_SDA	IN/OUT	Ext. smartcard driver I^2C SDA		8.3.1
21	SER_RX	IN	Serial port – host to H663	**External pull-up required**	5.5
22	SER_TX	OUT	Serial port – H663 to host		5.5
23	/LED4	OUT	LED 4	*BLUE*	5.3
24	/LED3	OUT	LED 3	*YELLOW*	5.3
25	/RESET	IN	H663 reset	Internal pull-up	5.1.2
26	/SUSPEND	IN	Contactless OFF	Internal pull-up	5.1.3

Table continuing next page

Table 1 (continuing)

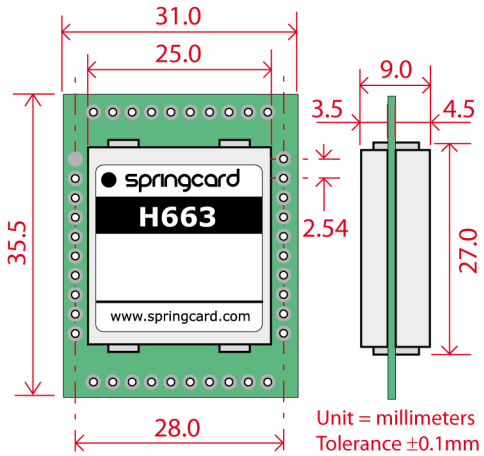
PIN	NAME	Type	Description	Remark	See §
27	/LED1	OUT	LED 1	*RED*	5.3
28	/LED2	OUT	LED 2	*GREEN*	5.3
29	GND	Ground	Ground		
30	VCC	Power	Power supply		5.1.1
31	/WAKEUP	IN	H663 wakeup	Internal pull-up	
32	GPIO1	IN/OUT			5.4
33	GPIO2	IN/OUT			5.4
34	GPIO3	IN/OUT			5.4
35	MODE1	IN	Firmware operating mode	Internal pull-up	5.1.4
36	MODE2	IN	Firmware operating mode	Internal pull-up	5.1.4
37	SIGIN	IN	RC663's SIGIN	Leave unconnected if not used	
38	SIGOUT	OUT	RC663's SIGOUT	Leave unconnected if not used	
39	GPIO4	IN/OUT			5.4
40	ANT_SEL			Leave unconnected	

Lines with a grey background are related to smartcard operation, and therefore are relevant for **H663AC** only. For **H663A**, these lines must remain unconnected.

For correct operation, all VCC pins shall be connected to power supply, and all GND pins shall be connected to ground.

3. Hardware and pinout – H663S, H663SC

3.1. Dimensions



3.2. Pinout

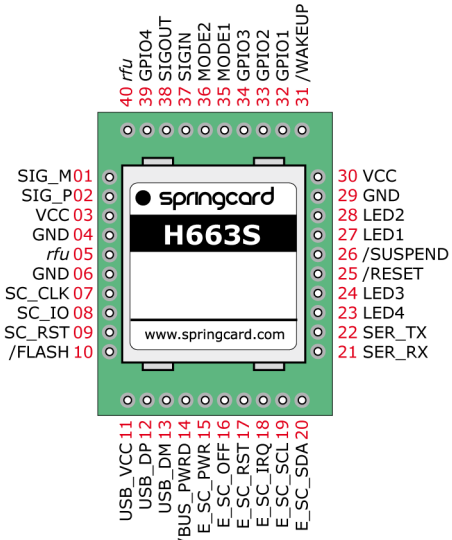


Table 2: pinout details for H663S

PIN	NAME	Type	Description	Remark	See §
1	SIG_M	Analog	Symmetric antenna		7.1
2	SIG_P	Analog	Symmetric antenna		7.1
3	VCC	Power	Power supply		5.1.1
4	GND	Ground	Ground		
5	3V3	Power	3,3V Power supply	Power Output 100mA Max	
6	GND	Ground	Ground		
7	SC_CLK	OUT	Smartcard clock		8.2.1/8.3.1
8	SC_IO	IN/OUT	Smartcard I/O		8.2.1/8.3.1
9	SC_RST	OUT	Smartcard reset		8.2.1/8.3.1
10	/FLASH	IN	Firmware upgrade	Internal pull-up	5.1.5
11	USB_VCC	Power	Bus power supply for USB link		5.1.1/5.2
12	USB_DP	IN/OUT	USB D+		5.2
13	USB_DM	IN/OUT	USB D-		5.2
14	/USB_PWRD	IN	H663 is powered by the bus		5.2
15	/E_SC_PWR	OUT	Ext. smartcard driver power enable		8.3.1
16	E_SC_OFF	OUT	Ext. smartcard driver bypass mode		8.3.1
17	/E_SC_RST	IN/OUT	Ext. smartcard driver reset		8.2.1/8.3.1
18	/E_SC_IRQ	IN	Ext. smartcard driver interrupt		8.3.1
19	E_SC_SCL	IN/OUT	Ext. smartcard driver I^2C SCL		8.3.1
20	E_SC_SDA	IN/OUT	Ext. smartcard driver I^2C SDA		8.3.1
21	SER_RX	IN	Serial port – host to H663	**External pull-up required**	5.5
22	SER_TX	OUT	Serial port – H663 to host		5.5
23	/LED4	OUT	LED 4	*BLUE*	5.3
24	/LED3	OUT	LED 3	*YELLOW*	5.3
25	/RESET	IN	H663 reset	Internal pull-up	5.1.2
26	/SUSPEND	IN	Contactless OFF	Internal pull-up	5.1.3

Table continuing next page

Table 2 (continuing)

PIN	NAME	Type	Description	Remark	See §
27	/LED1	OUT	LED 1	*RED*	5.3
28	/LED2	OUT	LED 2	*GREEN*	5.3
29	GND	Ground	Ground		
30	VCC	Power	Power supply		5.1.1
31	/WAKEUP	IN	H663 wakeup	Internal pull-up	
32	GPIO1	IN/OUT			5.4
33	GPIO2	IN/OUT			5.4
34	GPIO3	IN/OUT			5.4
35	MODE1	IN	Firmware operating mode	Internal pull-up	5.1.4
36	MODE2	IN	Firmware operating mode	Internal pull-up	5.1.4
37	SIGIN	IN	RC663's SIGIN	Leave unconnected if not used	
38	SIGOUT	OUT	RC663's SIGOUT	Leave unconnected if not used	
39	GPIO4	IN/OUT			5.4
40	ANT_SEL			Leave unconnected	

Lines with a grey background are related to smartcard operation, and therefore are relevant for **H663SC** only. For **H663S**, these lines must remain unconnected.

For correct operation, all VCC pins shall be connected to power supply, and all GND pins shall be connected to ground.

4. Electrical characteristics

4.1. 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

4.2. Operating condition range

SYMBOL	Parameter	Condition	Min	Typ	Max	Unit
$T_{OPERATION}$	Operating temperature		-20	+25	+70	°C
VCC	Supply voltage		3.0	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	

[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 draw up to 60mA. When an external smartcard driver is used (§ 4.8), the power supply shall be able to deliver 60mA per slot typically.

4.3. Input pin characteristics

Pins RX, /SUSPEND, /RESET, /FLASH, /WAKEUP 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

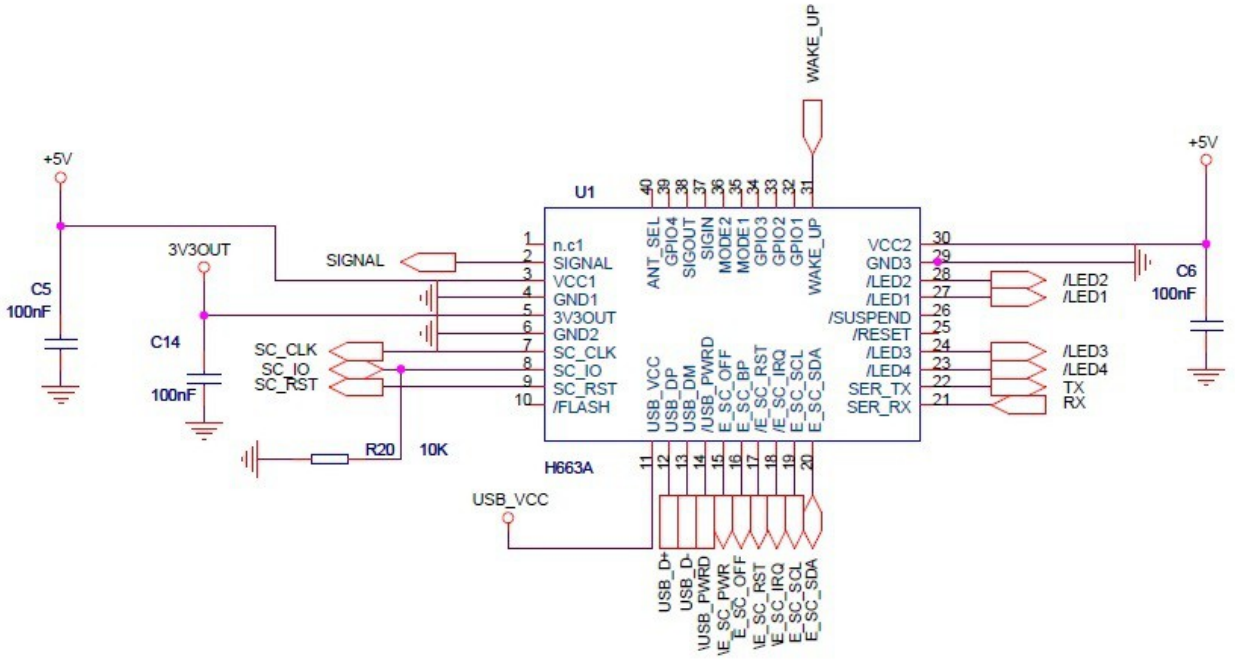
4.4. Output pin characteristics

Pins TX, /ANT_SEL, /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

5. Integration guide

5.1. General



This schematics depicts a H663A but also applies to H663S in all aspects but the link to the antenna (same pinout but pins 1 & 2).

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

5.1.1. Power supply

a. No USB, or USB plus external power source

- Connect both VCC pins (#3 and #30) to the DC power supply (3 to 5V),
- Leave pin /USB_PWRD (#14) unconnected, or tie it to HIGH level.

b. USB – Bus powered operation

- Connect USB's VBUS line to USB_VCC (#11) and to the VCC pins (#3 and #30),
- Tie pin /USB_PWRD (#14) to LOW level.

See § 5.2 for more details regarding the USB interface.

*Care must be taken that all the external components SHALL NOT draw more than 5mA until the host has allowed the module to power up fully. The **H663** sets its pin /E_SC_PWR (#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 NEVER draw more than 150mA from the USB power line (the **H663** asks for 400mA in its USB descriptor, and needs up to 250mA for itself, leaving 150mA available to the external components).*

5.1.2. Reset

The **H663** 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.

Tip: if you don't have to be able to reset the module externally, you may leave the /RESET pin unconnected.

When /RESET is set to LOW, the module's CPU stops. When /RESET is set to 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 "H663" 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.

5.1.3. Contactless OFF

The /SUSPEND pin (#26) is intended to put the stop the H663's contactless interface.

When /SUSPEND is set to LOW, the RF field is shut down and the RF front-end is powered down. If a contactless card was present, a PC/SC “card removed” event is triggered. This could takes up to 100ms.

When /SUSPEND state is set to HIGH again, the contactless interface resumes in less than 100ms.

IMPORTANT DISCLAIMER:

Do not set /SUSPEND to LOW for less than 150ms.
Do not set /SUSPEND to HIGH for less than 250ms.
Failure to do so could lead to errors on the computer side (coupler not behaving as the PC/SC subsystem and CCID driver expect)

5.1.4. Firmware operating mode

The MODE1 and MODE2 pins (#35 and #36) select the operating mode of the firmware. Every standard firmware behaves as follow:

MODE1	MODE2	Firmware operating mode
H	H	PC/SC mode (CCID profile), USB serial number is different for every module
H	L	PC/SC mode (CCID profile), USB serial number is fixed to “.....”
L	H	Test mode 1 (factory only, do not use)
L	L	Test mode 2 (factory only, do not use)

Tip: in a typical setup you may leave both pins unconnected, so they are read as being H,H.

For the other (non-standard) firmwares, please refer to the actual documentation of the firmware or final product to know the role of the MODE1 and MODE2 pins.

5.1.5. Firmware upgrade

The /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. The **H663** uses the standard USB DFU profile (USB Device Firmware Upgrade). Please refer to the page "H663/H512 family firmware upgrade procedure" hosted on **SpringCard's developer blog** for details.

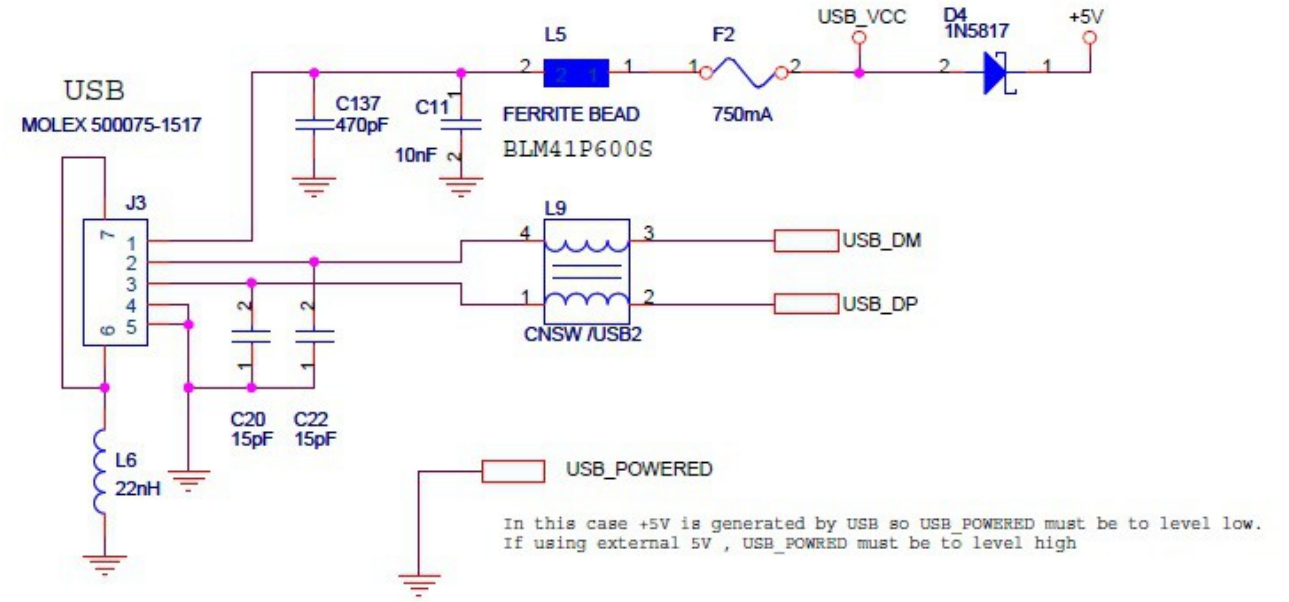
IMPORTANT DISCLAIMER:

DO NOT TRY TO UPGRADE THE FIRMWARE while the RF field is switched ON and/or the smartcard interface is running. To enter firmware upgrade mode safely, please either cycle power after setting the /FLASH pin to low, or switch RF field to OFF and disable the smartcard interface by sending appropriate software commands before any action on the /RESET pin.

5.2. USB Interface

5.2.1. Schematics

The **H663** features a USB 2.0 device interface. Observe the following schematic to implement this interface according to USB hardware specifications.



Note: MOLEX 500075-1571 is a mini type B USB connector.

5.2.2. Powered by the bus, or external power

The /USB_PWRD pin (#14) tells the firmware whether the module has an external power supply or is powered by the bus.

/USB_PWRD	Impact on firmware
L	USB descriptor announces “bus powered, 400mA” The /E_SC_PWR pin remains HIGH until the **H663** has been enumerated and configured by the USB host.
H	USB descriptor announces “bus powered, external power, 50mA” The /E_SC_PWR pin is set to LOW as soon as the **H663** starts

IMPORTANT DISCLAIMER:

Setting /USB_PWRD to the correct value for your hardware is important. If the H663 claims it has an external power supply, yet tries to drain more than 50mA from the bus due to a missing external power source, the USB host is likely to drop the link and signal a fatal error.

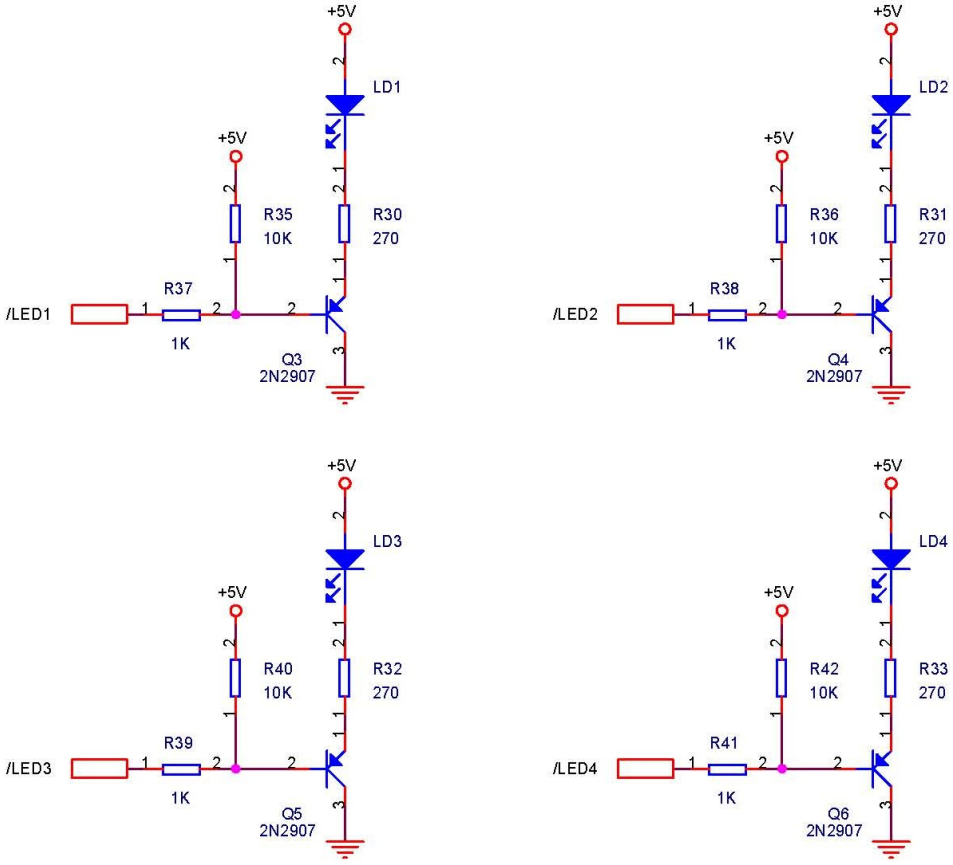
5.2.3. USB cable

Due to the chosen values for C20, C22 and L9, the length of the USB cable shall not exceed 1.8m.

Please contact us in case you need to connect the **H663** through a longer cable.

5.3. LED DRIVERS

H663 LED output lines are active LOW and must be buffered to drive the LEDs. Use bipolar transistors, as follow:



5.4. GPIOs

The GPIOs pins are configured as input upon start-up.

- Any call to a “GPIO write” instruction will configure the related GPIO pin as output.
- Any call to a “GPIO read” instruction will reconfigure the related GPIO pin as input.

Please refer to document **PMD2271 : H663 Developer's reference manual** for details regarding both instructions.

5.4.1. Using a GPIO as output

The GPIO pins shall not drive more than 4mA (see § 4.4). Use the same schematics (i.e. use a transistor) as for the LED output lines (see § 5.3).

5.4.2. Using a GPIO as input

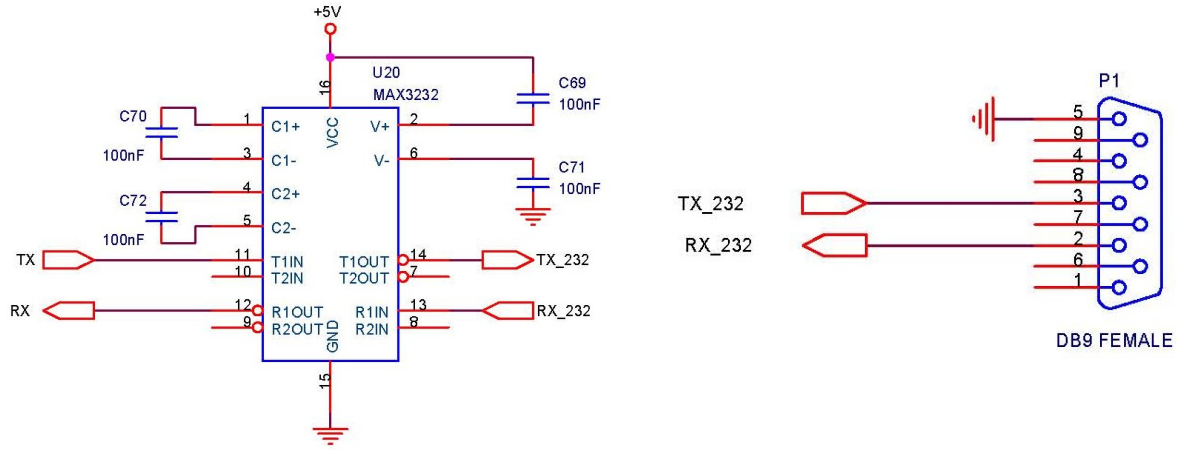
It is recommended to insert a 100Ω resistor in the signal path between your system's output and the **H663**'s GPIO used as input.

Doing so, the chips will not be damaged in case the **H663**'s GPIO is erroneously configured as output.

5.5. Serial interface

The **H663** features a serial communication interface at TTL-level (CMOS tolerant) for debugging and in case a custom firmware is running.

Observe the following schematic to implement this interface according to RS-232 specifications (+12V/-12V, DB9 plug).



5.6. Recommended BOM

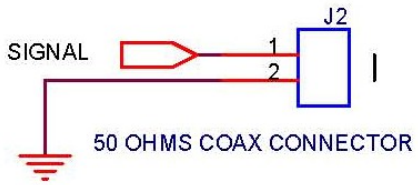
Component	Value	Tolerance	Recommended part #	Manufacturer
C11	10nF/25V	10%	2238-587-15636	PHYCOMP
C5, C6, C14, C69, C70, C71, C72	100nF/25V	10%	0402YD104KAT2A	AVX
C20, C22	15pF/50V	5%	2238-869-15159	PHYCOMP
C137	470pF/50V	10%	2238-587-15518	PHYCOMP
R20, R35, R36, R42	10K	5%	232270570103	PHYCOMP
R37, R38, R39, R41	1K	5%	232270570102	PHYCOMP
R30, R31, R32, R33	270	5%	232270260271	PHYCOMP
Q3, Q4, Q5, Q6			MMBT2907A	FAIRCHILD
L5			BLM41PG600SN1L	MURATA
L6	22nH	5%	NLV32T-022J-PF	TDK
L9			744231091	WURTH
D4			PRLL5817	NXP
F2	750mA		MINISMDC075F-2	TYCO
J2			U.FL-R-SMT-1(10)	HIROSE
J3			675031020	MOLEX
P1			D09P13A4GX00LF	FCI
U20			MAX3232CUE+	MAXIM

6. Asymmetric (balanced) antenna (H663A, H663AC)

6.1. The SIGNAL pin

H663's SIGNAL pin (#2) is designed 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: 2m). Therefore, the SIGNAL pin shall be linked to a coaxial connector within the minimum distance.



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

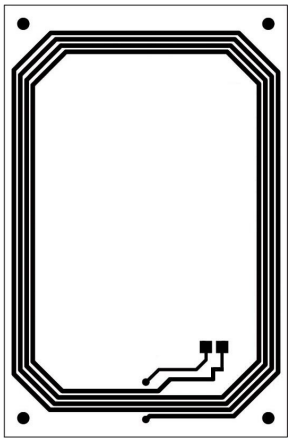
6.2. Reference antenna

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, with 2 copper layers: one for the antenna, the other for the EMC shielding.

6.2.1. Antenna loop

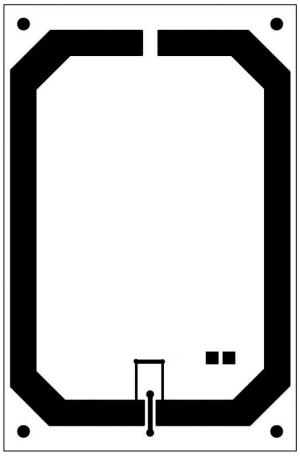
The antenna shall have an inductance between 300nH and 1.5µH. This gives us 4 turns in the available surface.



6.2.2. 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).

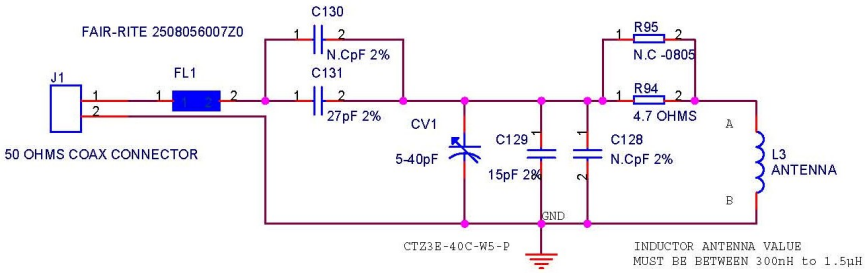
The shield is a large open loop, tied to Ground, on the opposite side of the active loop.

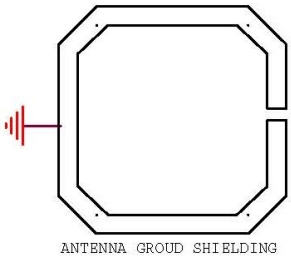


6.2.3. Matching and tuning circuit

This circuit has two 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), and
- **Match** the antenna to 50Ω (C129, C130), so it can't be connected to **H663**'s SIGNAL pin either directly or through a coaxial cable.





6.3. Recommended BOM

Component	Value	Tolerance	Recommended part #	Manufacturer
J1			U.FL-R-SMT-1(10)	HIROSE
C130, C1280	*Unmounted*			
R95	*Unmounted*			
C131	27pF/100V	2%	06031U270GAT2A	AVX
C129	15pF/100V	2%	06031U150GAT2A	AVX
R94	4,7	5%	232273464708	PHYCOMP
CV1	5-30pF		TZC3P300A110R00	MURATA
FL1			2508056007Z0	FAIR-RITE

6.4. Designing a custom antenna

Designing an antenna for 13.56MHz RFID or NFC applications requires 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

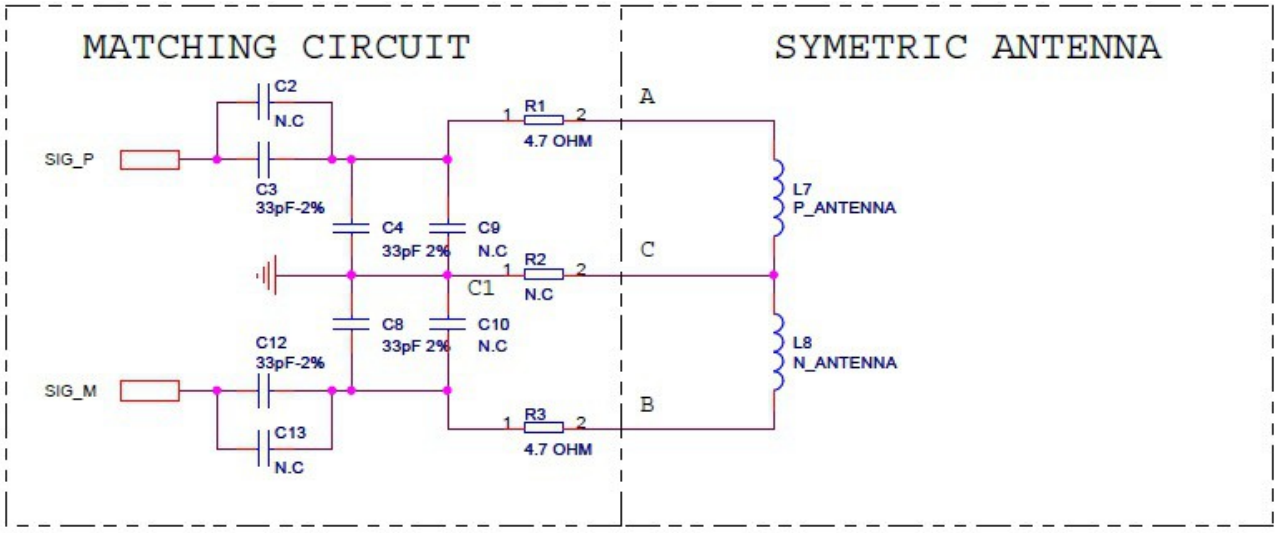
The RF chipset in H663 is NXP CLRC663. Please take into account RC663's limiting characteristics. **SpringCard** engineers have a strong experience in antenna design. Do not hesitate to consult us any time you need a custom design.

7. Symmetric (balanced) antenna (H663S, H663SC)

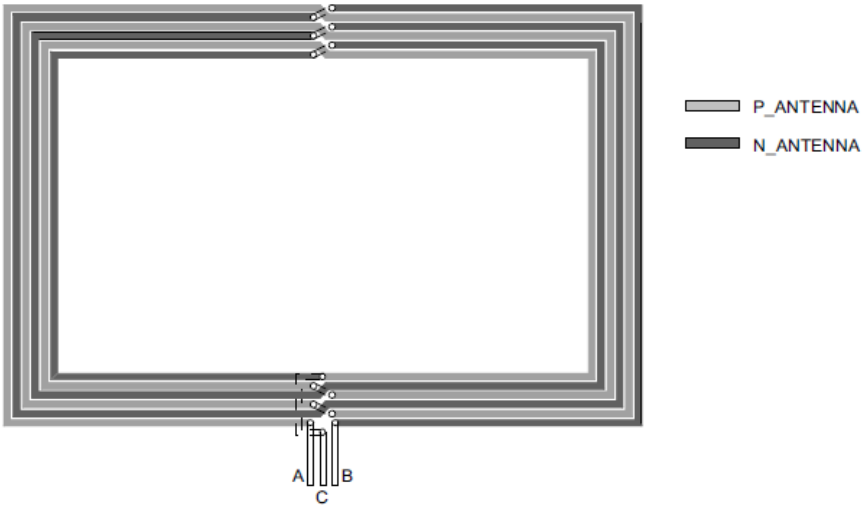
7.1. The SIG_P and SIG_M pins

H663's SIG_N pin (#1) and SIG_P pin (#2) are designed to drive a **balanced antenna.**

The antenna shall be connected to the module with 50mm maximum distance.



7.2. Antenna topology



7.2.1. Shielding

This antenna does not need ground plane protecting against H field like Unbalanced Antenna (see 6.2.2).

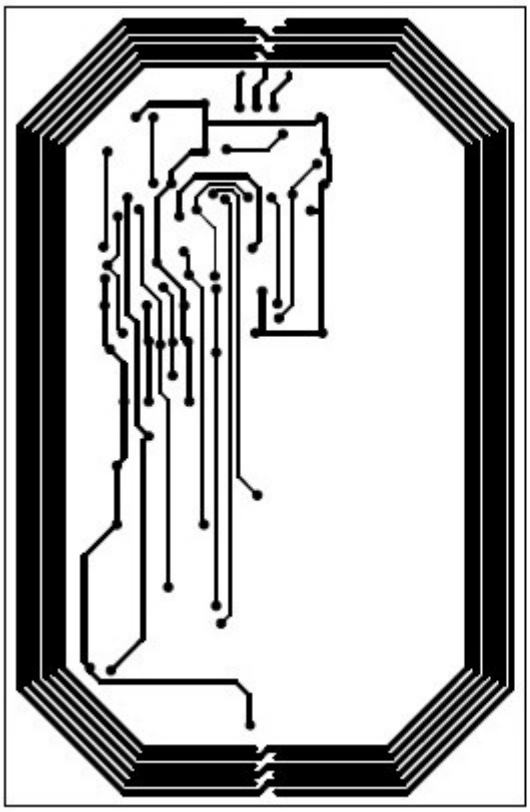
When P_Antenna has positive H field emission, the N_Antenna has an opposite H field emission, doing H fields vanish.

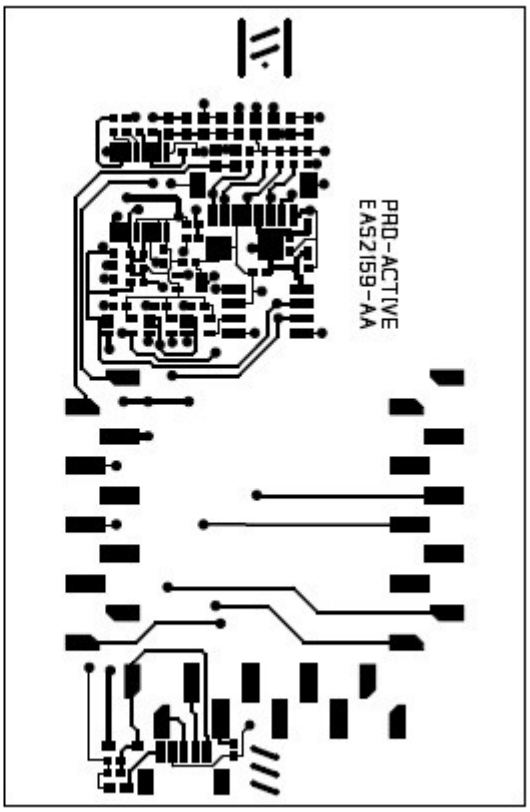
7.2.2. Matching and tuning circuit

This circuit has two roles:

- **Tune up** P_antenna and N_Antenna as a band-pass filter centred on 13.56MHz (C4, C9, C8, C10) with a **quality factor** (Q) of approx. 40 (R1, R3).
- **Match** P_antenna and N_Antenna to 100Ω (C2, C3, C12, C13).

7.3. Antenna reference





7.4. Recommended BOM

Component	Value	Tolerance	Recommended part #	Manufacturer
C2, C9, C10, C13	*Unmounted*			
R2	*Unmounted*			
C3, C12	33pF/100V	2%	06031U270GAT2A	AVX
C4,C8	12pF/100V	2%	06031U150GAT2A	AVX
R94	4,7	5%	232273464708	PHYCOMP

7.5. Designing a custom antenna

Designing an antenna for 13.56MHz RFID or NFC applications requires 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.

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The RF chipset in H663 is NXP CLRC663. Please take into account RC663's limiting characteristics. **SpringCard** engineers have a strong experience in antenna design. Do not hesitate to consult us any time you need a custom design.

8. SmartCard & SAM slots (H663AC, H663SC)

The **H663**'s smartcard subsystem supports a large variety of configurations. The actual configuration is discovered on startup by probing the external composants.

Configuration	Description	Supported by H663A / H663S	Supported by H663AC / H663SC	See §
No smartcard multiplexer				
1 SAM	Connect the SAM directly to **H663**'s SC_CLK, SC_IO and SC_RST pins. No *presence* input, no PWR control.	No	**Yes**	8.2
Using AT83C26 smartcard multiplexer				
1 ID-1 smartcard	Connect the card to AT83C26's slot #1	No	**Yes**	8.3
1 SAM	Connect the SAM to AT83C26's slot #2	No	**Yes**	8.3
3 SAMs	Connect the SAMs to AT83C26's slots #3, #4, #5	No	**Yes**	8.3
4 SAMs	Connect the SAMs to AT83C26's slots #2, #3, #4, #5	No	**Yes**	8.3
1 ID-1 smartcard + 3 SAMs	Connect the card to AT83C26's slot #1 Connect the SAMs to AT83C26's slots #3, #4, #5	No	**Yes**	8.3
1 ID-1 smartcard + 4 SAMs	Connect the card to AT83C26's slot #1 Connect the SAMs to AT83C26's slots #2, #3, #4, #5	No	**Yes**	8.3

NB: H663A and **H663S** have no support for smartcards.

8.1. No smartcard mode

Tie the /E_SC_RST pin (#17) to LOW level in order to disable the smartcard subsystem of **H663AC** or **H663SC.**

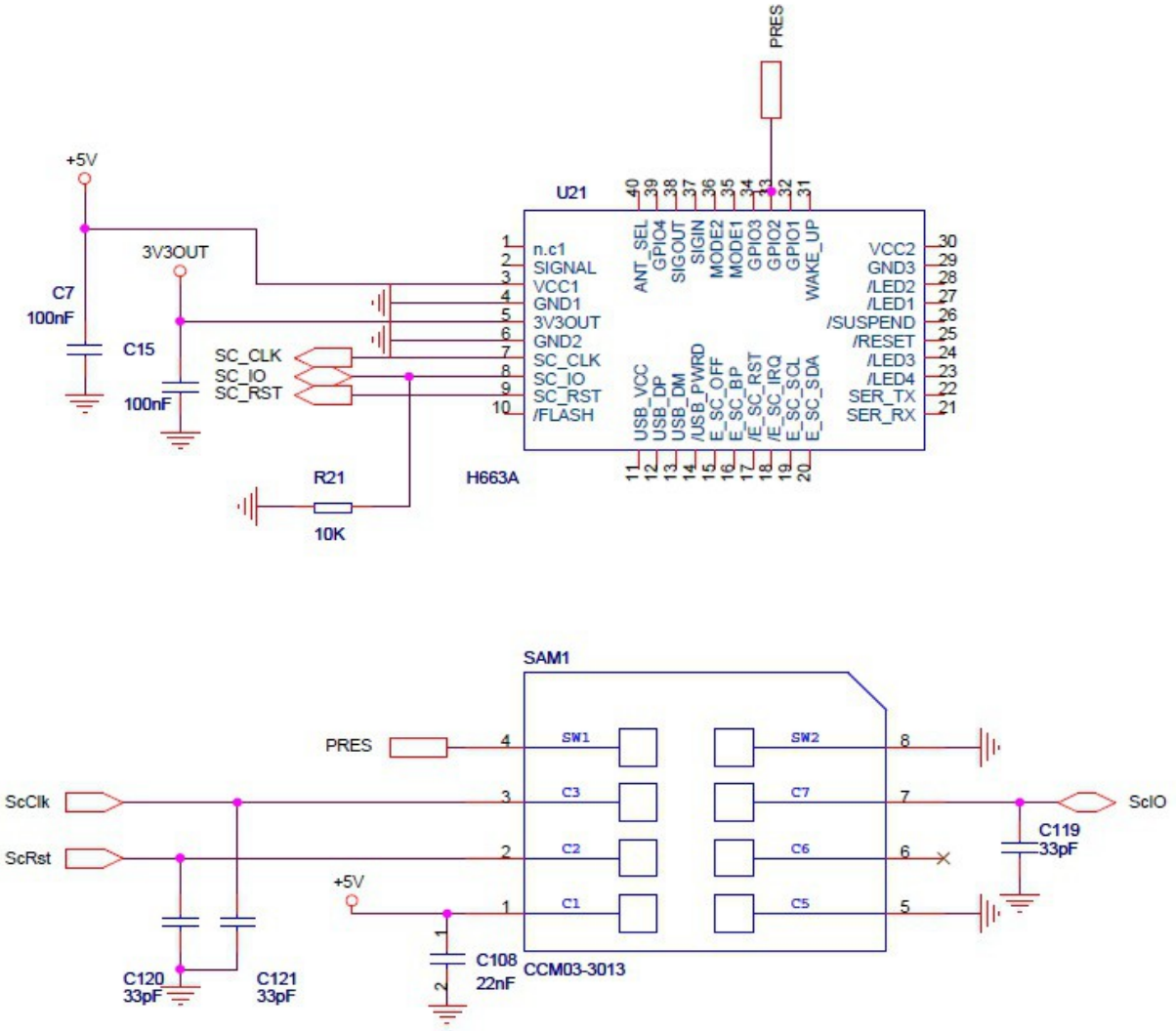
8.2. Single SAM mode

The **H663SC** and **H663AC** are able to manage 1 SAM without requiring any external component.

To select the single SAM mode, leave the /E_SC_RST pin (#17) and the I²C bus (#19 and #20) unconnected.

There's no “card present” input in this mode (the detection of the SAM is performed only upon reset).

8.2.1. Reference schematics – single SAM mode



(C1 pin off SAM1 can be connected to 3V3OUT for 3,3V application)

8.2.2. Recommended BOM – single SAM mode

Component	Value	Tolerance	Recommended part #	Manufacturer
SAM	ID-000 smartcard slot		CCM03-3013	ITT CANNON
C7, C15	100nF/25V	10%	0402YD104KAT2A	AVX
C108	22nF/16V	10%	0402YC223KAT2A	AVX
C120, C121	33pF/50V	5%	04025A330JAT2A	AVX
R20	10K	5%	232270570103	PHYCOMP

8.3. Multi Smartcard and SAM interfaces

The **H663AC** and **H663SC** are able to drive up to 1 smartcard and 4 SAMs thanks to an external smartcard multiplexer, the **Inside Secure's AT83C26** chip (formerly an Atmel product).

The **AT83C26** smartcard multiplexer must be connected to the **H663** through

- The smartcard interface pins SC_CLK, SC_IO and SC_RST (pins 07, 08 and 09),
- The smartcard multiplexer control pins /E_SC_PWR, E_SC_OFF, /E_SC_RST and /E_SC_IRQ (pins 15, 16, 17 and 18),
- The I^2C bus (pins 19 and 20).

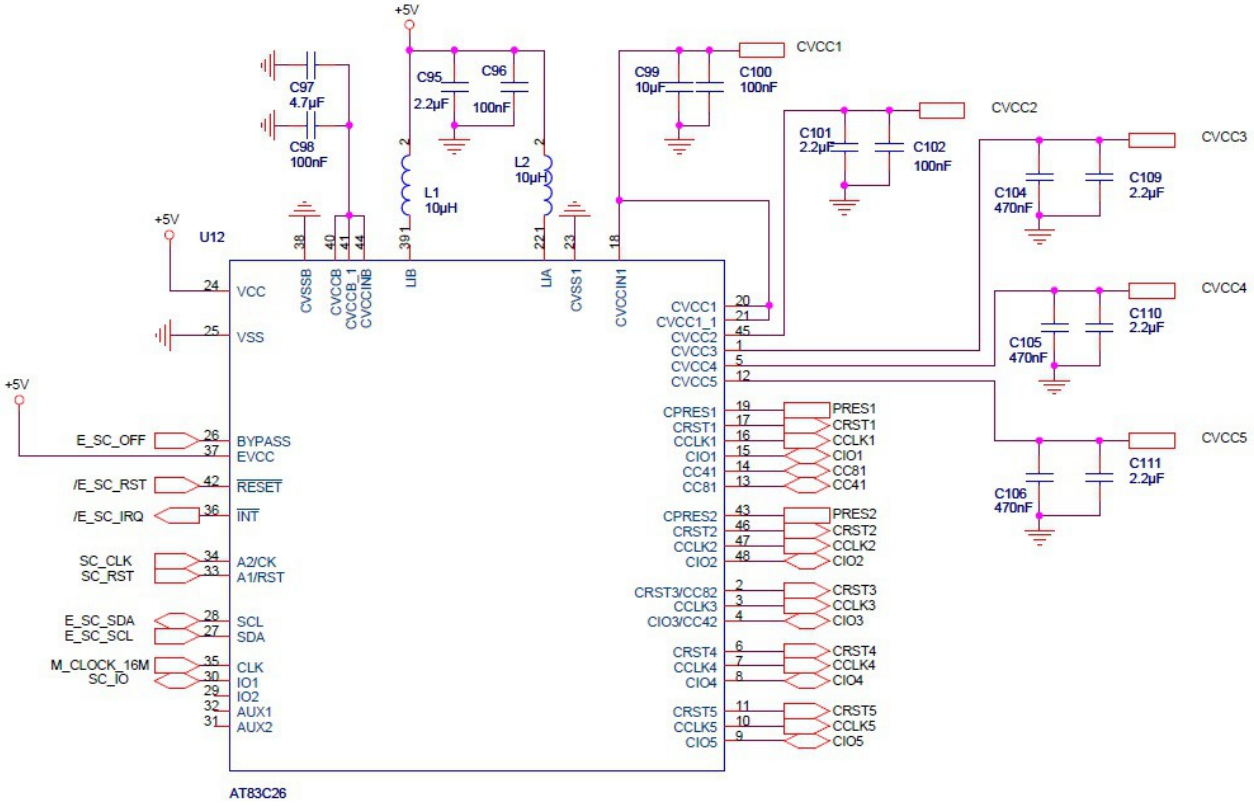
Please refer to **Inside Secure's AT83C26 technical datasheet** for a complete understanding of the design:

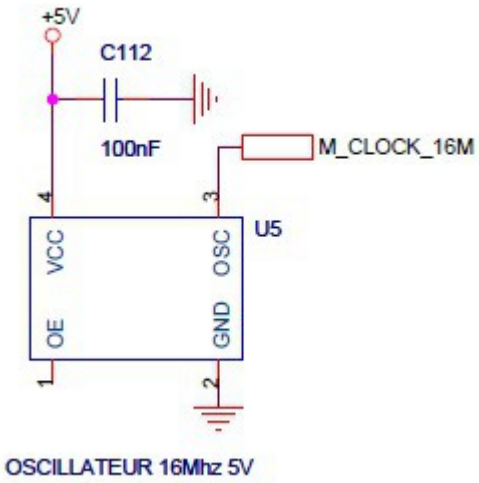
http://www.insidesecure.com/eng/content/download/974/9263/version/2/file/TPR0508A+-+AT83C26_Datasheet.pdf

An I^2C I/O expander chip (**NXP PCF8574ATS**) is also required to configure the **H663**'s smartcard subsystem (see § 8.3.4), and to provide 'presence' input for the SAM slots #3 to #5.

8.3.1. Reference schematics – multi smartcard/SAM mode

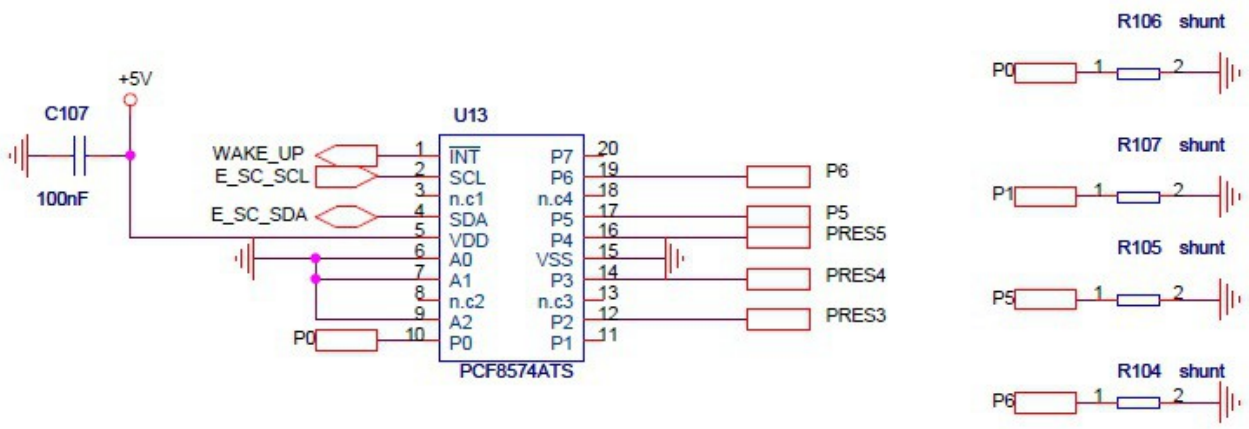
a. AT83C26 and peripherals





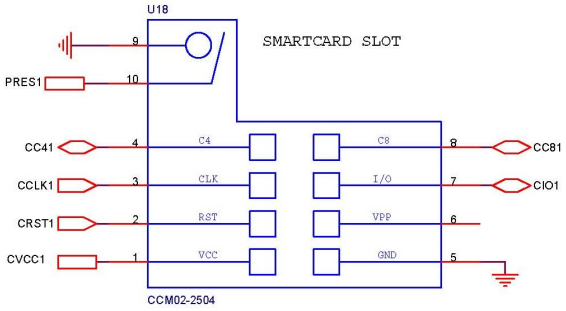
OSCILLATEUR 16Mhz 5V

b. Slot 3 to 5 detection presence and options configurations

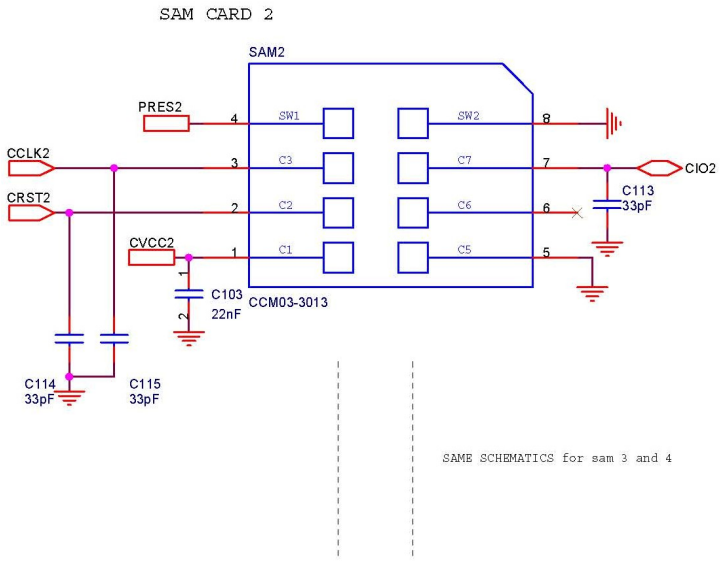


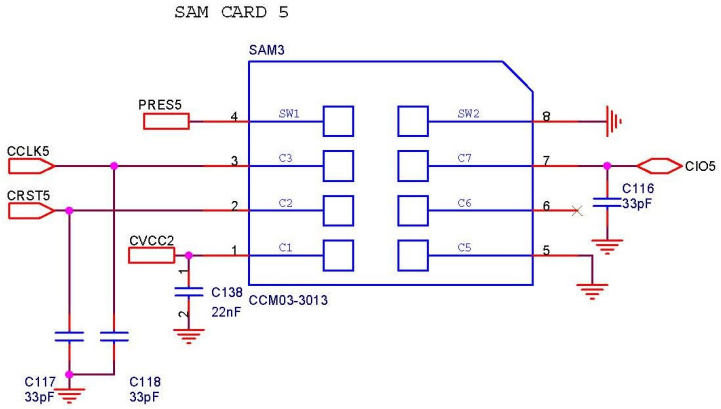
c. Slot #1 (ID-1 smartcard)

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



d. Slots #2 to #5 (SAM slots)



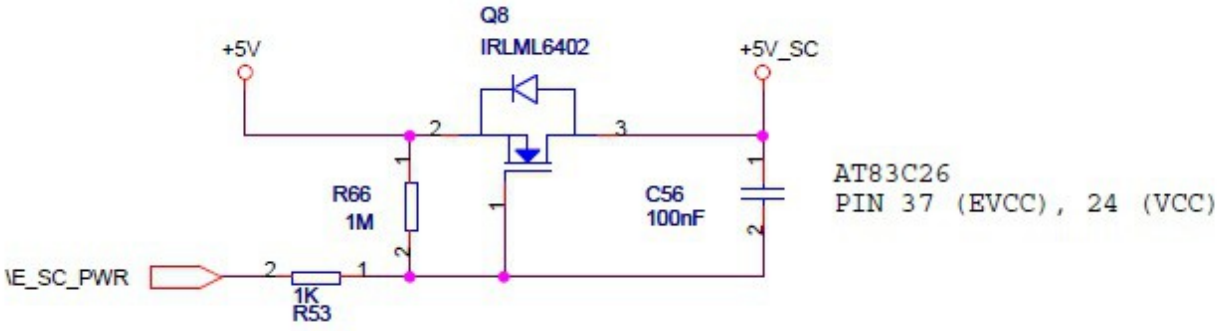


8.3.2. Recommended BOM – multi smartcard/SAM mode

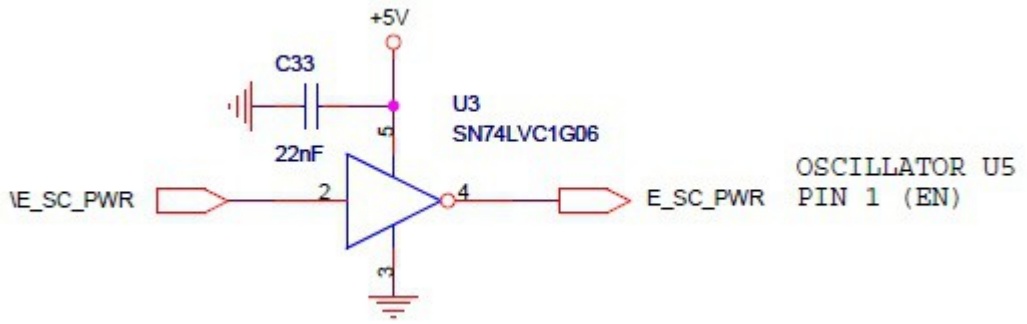
Component	Value	Tolerance	Recommended part #	Manufacturer
U12			AT83C26	Inside Secure
U13	I^2C I/O expander		PCF8574ATS	NXP
CARD1	ID-1 smartcard slot		CCM02-2504	ITT CANNON
SAM2	ID-000 smartcard slot		CCM03-3013	ITT CANNON
SAM3	ID-000 smartcard slot		CCM03-3013	ITT CANNON
SAM4	ID-000 smartcard slot		CCM03-3013	ITT CANNON
SAM5	ID-000 smartcard slot		CCM03-3013	ITT CANNON

8.3.3. Advices regarding the placement and routing

AT83C26's 5V power supply is driven by **H663**'s E_SC_PWR pin (#15).



AT83C26's oscillation circuit (U5's pin 1) can be disabled by inverting H663's E_SC_PWR using an open collector inverter gate.



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).

8.3.4. Specifying the smartcard/SAM configuration

The **H663** reads its configuration from the levels on 3 of the PCF8574's pins:

PCF8574's pins			Impact on the firmware (at power up)
P0	**P1**	**P5**	
PCF8574 not found on the I²C bus			slot #2 on AT83C26 (1st SAM) is enabled all other slots are disabled
0	-	-	slot #1 on AT83C26 (ID-1 smartcard) is enabled
1	-	-	slot #1 on AT83C26 (ID-1 smartcard) is disabled
-	-	0	slot #2 on AT83C26 (1st SAM) is disabled
-	-	1	slot #2 on AT83C26 (1st SAM) is enabled
-	0	-	slots #3, #4 and #5 (other SAMs) are enabled
-	1	-	slots #3, #4 and #5 (other SAMs) are disabled

Note 1: It is not possible to enable/disable the slots #3 to #5 individually.

Note 2: logic is inverted for slot #2. This is not a typo.

8.3.5. Card presence switches for the SAM slots

3 pins of the PCF8574 are used to detect the presence of the SAM is the slots #3, #4 and #5 (the slots #1 and #2 have 'presence' input directly on the AT83C26)

PCF8574's pins			Impact on the firmware (at power up)
P2	**P3**	**P4**	
0	-	-	SAM is present in slot #3
1	-	-	SAM is absent in slot #3
-	0	-	SAM is present in slot #4
-	1	-	SAM is absent in slot #4
-	-	0	SAM is present in slot #5
-	-	1	SAM is absent in slot #5

If your SAM connectors don't have a 'presence' output pin, tie the corresponding entries to level (ground), so the **H663** will probe the slots to see whether a SAM actually answers or not.

9. USB IMPLEMENTATION

9.1. STANDARD AND PROFILE

The **H663** complies with

- USB, revision 2.0 (April 27rd, 2000),
- USB Device Class : Specification for Integrated Circuit(s) Cards Interface Devices (CCID), revision 1.1 (April 22rd, 2005),
- PC/SC part. 2, revision 2.01.01 (September 2005),
- PC/SC part. 3, revision 2.01.09 (June 2007),
- PC/SC part. 3 supplemental document, revision 2.01.08 (June 2011).

9.2. PRODUCT IDENTIFICATION IN THE USB DESCRIPTOR

9.2.1. Vendor ID and Product ID

Vendor ID	Product ID		
	PC/SC mode (standard)	CDC mode (RFU)	HID mode (RFU)
$_H$1C34	$_H$91B1	$_H$90B1	$_H$92B1

9.2.2. Vendor name

Vendor Name
SpringCard

9.2.3. Product name

Vendor Name	Product Name
H663A, H663S, H663AC, H663SC	H663

9.3. Drivers and software support

Please refer to document **PMD2271 : H663 Developer's reference manual** .

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