Advanced Card Systems Limited

Card and Reader Technologies

ACR122S

User Manual

ACR122S PC-linked Contactless Card Reader

1.0 INTRODUCTION

The ACR122S is a PC-linked Contactless Smart Card Reader/Writer developed on the 13.56MHz Contactless Technology. This device is designed to support not only MiFare and ISO14443 Type A and B Cards but also FeliCa and NFC tags.

By making use high-speed card access and Serial port speed of 115.200 Kbps, read and write operations are faster and more efficient. With its compact size and trendy design and with the various features the ACR122S offers,you can experience the convenience in using ACR122S for applications of payment,mass transit, physical access control, time attendance, etc.

2.0 FEATURES

- Serial Interface. Baud Rate = 9600 bps (default) or 115200 bps, 8-N-1. Initial Baud Rate is determined by the existence of R12. A command is also provided for changing the baud rate while the reader is running.
- CCID-liked Frame Format.
- Support ISO14443 Part 4 Type A & B, MIFARE, FeliCa and NFC tags.
- Built-in Antenna for contactless tags access.
- Support ISO7816 T=0 cards. (SAM Socket)
- Bi-Color LED.
- Buzzer.
- 2 Relays (optional)
- 8 buffered TTL Input pins (optional)
- 8 buffered TTL Output pins (optional)

3.0 Typical Applications

- Network access control
- Micro-payment
- NFC mobile tag
- Public Transportation Terminals
- Automatic Fare Collection
- Physical access control
- Customer Loyalty
- Time attendance
- Contactless public phones
- Vending machines

4.0   Installation Procedure

Connect the ACR122S DB9 cable to the PC serial port and plug the USB cable into the USB port. The USB is provided the power only. When the reader connects to the PC, then the user can use it directly. It doesn't need any windows driver to start up the reader.

5.0   Hardware Interfaces

5.1 Bi-Color LED

- User-controllable Bi-Color LED. Red and Green Color.

- The Green Color LED will be blinking if the "Card Interface" is not connected.
- The Green Color LED will be turned on if the "Card Interface" is connected.
- The Green Color LED will be flashing if the "Card Interface" is operating.
- The Red Color LED is controlled by the application only.

5.2 Buzzer

- User-controllable buzzer.
- The default Buzzer State is OFF

5.3 SAM Interface
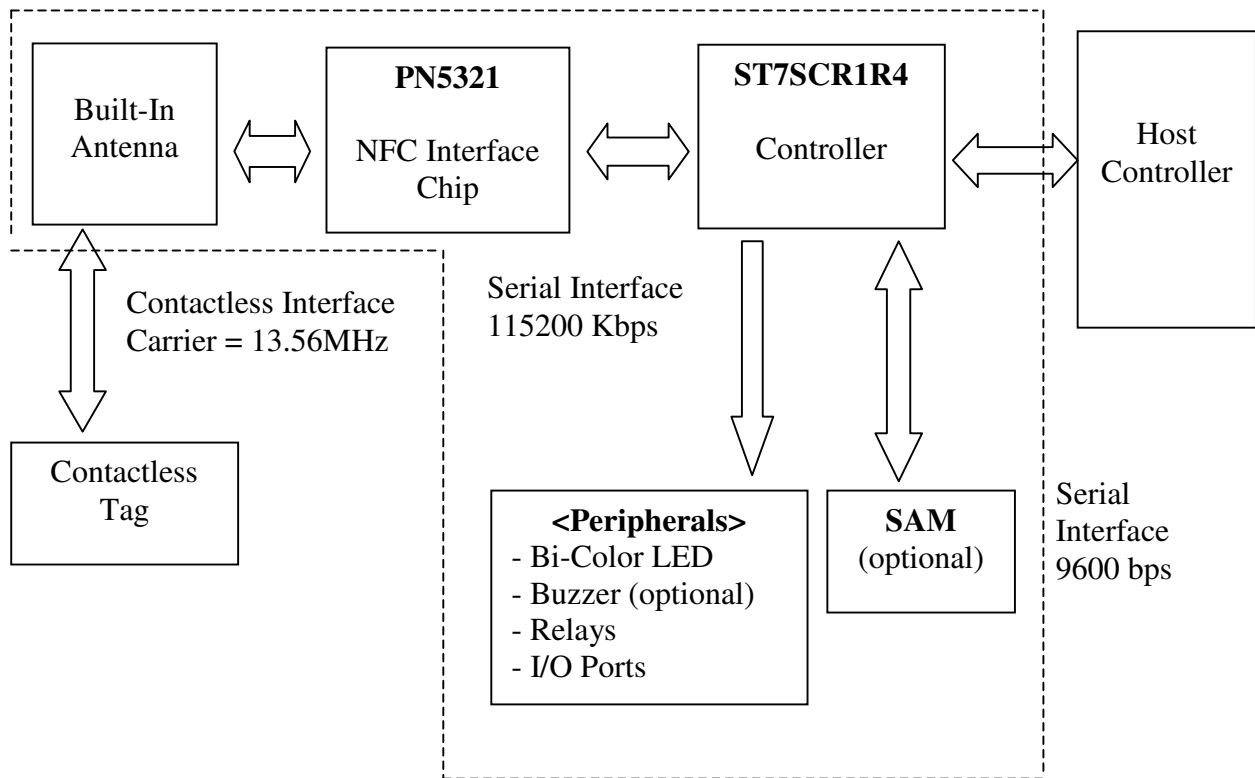
- One SAM socket is provided.

5.4 Built-in Antenna

- 3 turns symmetric loop antenna.Center tapped.
- The estimated size = 50mm x 40mm.
- The loop inductance should be around ~ 1.6uH to 2.5uH
- Operating Distance for different Tags ~ up to 50mm (depend on the Tag)
- No anti-collision. Only one Tag can be accessed at any one time.

6.0   Implementation

The ACR122S is built based on the   ST7SCR1R4   and PN5321 chips.

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| Built-In Antenna | ⟺ | **PN5321** NFC Interface Chip | ⟺ | **ST7SCR1R4** Controller | ⟺ | Host Controller |

Contactless Interface Carrier = 13.56MHz

Serial Interface 115200 Kbps

Contactless Tag

<Peripherals>
- Bi-Color LED
- Buzzer (optional)
- Relays
- I/O Ports

SAM (optional)

Serial Interface 9600 bps

ACR122S System Block Diagram

7.0 Serial Interface (CCID-liked FRAME Format)

Communication setting: 9600 bps, 8-N-1
The communication protocol between the Host and ACR122S is very similar to the CCID protocol.

ACR122S Command Frame Format

STX (0x02)	Bulk-OUT Header	APDU Command Or Parameters	Checksum	ETX (0x03)
1 Byte	10 Bytes	M Bytes (If applicable)	1 Byte	1 Byte

ACR122S Status Frame Format

STX (0x02)	Status	Checksum	ETX (0x03)
1 Byte	1 Byte	1 Byte	1 Byte

ACR122S Response Frame Format

STX (0x02)	Bulk-IN Header	APDU Response Or abData	Checksum	ETX (0x03)
1 Byte	10 Bytes	N Bytes (If applicable)	1 Byte	1 Byte

Checksum = XOR {Bulk-OUT Header, APDU Command or Parameters}
Checksum = XOR {Bulk-IN Header, APDU Response or abData}

In general, we would make use of three types of Bulk-OUT Header.
- HOST_to_RDR_IccPowerOn: To activate the SAM interface. The ATR of the SAM will be returned if available.
- HOST_to_RDR_IccPowerOff: To deactivate the SAM interface.
- HOST_to_RDR_XfrBlock: To exchange APDUs between the Host and ACR122S-PM.

#The SAM interface must be activated in order to use the Contactless interface and Peripherals. In short, all the APDUs are exchanged through the SAM Interface.

Similarly, two types of Bulk-IN Header are used.
- RDR_to_HOST_DataBlock: In response to the "HOST_to_RDR_IccPowerOn" and "HOST_to_RDR_XfrBlock" Frames.
- RDR_to_HOST_SlotStatus: In response to the "HOST_to_RDR_IccPowerOff" Frame.

RDR=ACR122S,HOST=Host Controller.
HOST_to_RDR=Host Controller->ACR122S
RDR_to_HOST=ACR122S->Host Controller

8.0 To activate the SAM Interface

ACR122S Command Frame Format

STX (0x02)	Bulk-OUT Header (HOST_to_RDR_IccPowerOn)	Parameters	Checksum	ETX (0x03)
1 Byte	10 Bytes	0 Byte	1 Byte	1 Byte

HOST_to_RDR_IccPowerOn Format

Offset	Field	Size	Value	Description
0	bMessageType	1	62h	
1	dDwLength <LSB .. MSB>	4	00000000h	Message-specific data length
5	bSlot	1	00-FFh	Identifies the slot number for this command. Default=00h
6	bSeq	1	00-FFh	Sequence number for command
7	bPowerSelect	1	00h, 01h, 02h, or 03h	Voltage that is applied to the ICC 00h – Automatic Voltage Selection 01h – 5.0 volts 02h – 3.0 volts 03h – 1.8 volts
8	abRFU	2		Reserved for Future Use

ACR122S Response Frame Format

STX (0x02)	Bulk-IN Header (RDR_to_HOST_DataBlock)	abData	Checksum	ETX (0x03)
1 Byte	10 Bytes	N Bytes (ATR)	1 Byte	1 Byte

RDR_to_HOST_DataBlock Format

Offset	Field	Size	Value	Description
0	bMessageType	1	80h	Indicates that a data block is being sent from the ACR122S
1	dwLength <LSB .. MSB>	4	N	Size of abData field. (N Bytes)
5	bSlot	1	Same as Bulk-OUT	Identifies the slot number for this command
6	bSeq	1	Same as Bulk-OUT	Sequence number for corresponding command
7	bStatus	1		
8	bError	1		
9	bChainParameter	1		

9.0 To deactivate the SAM Interface

ACR122S Command Frame Format

STX (0x02)	Bulk-OUT Header (HOST_to_RDR_IccPowerOff)	Parameters	Checksum	ETX (0x03)
1 Byte	10 Bytes	0 Byte	1 Byte	1 Byte

HOST_to_RDR_IccPowerOff Format

Offset	Field	Size	Value	Description
0	bMessageType	1	63h	
1	dDwLength <LSB .. MSB>	4	00000000h	Message-specific data length
5	bSlot	1	00-FFh	Identifies the slot number for this command. Default=00h
6	bSeq	1	00-FFh	Sequence number for command
7	abRFU	3		Reserved for Future Use

ACR122S Response Frame Format

STX (0x02)	Bulk-IN Header (RDR_to_HOST_SlotStatus)	abData	Checksum	ETX (0x03)
1 Byte	10 Bytes	0 Byte	1 Byte	1 Byte

RDR_to_HOST_DataBlock Format

Offset	Field	Size	Value	Description
0	bMessageType	1	81h	Indicates that a data block is being sent from the ACR122S
1	dwLength <LSB .. MSB>	4	0	Size of abData field. (0 Bytes)
5	bSlot	1	Same as Bulk-OUT	Identifies the slot number for this command
6	bSeq	1	Same as Bulk-OUT	Sequence number for corresponding command
7	bStatus	1		
8	bError	1		
9	bClockStatus	1		

Example. To deactivate the slot 0 (default), sequence number = 2.

HOST -> 02 63 00 00 00 00 00 02 00 00 00 [Checksum] 03
RDR -> 02 00 00 03
RDR -> 02 81 00 00 00 00 00 02 00 00 00 [Checksum] 03

10.0 To do data-exchange through the SAM Interface

ACR122S Command Frame Format

STX (0x02)	Bulk-OUT Header (HOST_to_RDR_XfrBlock)	Parameters	Checksum	ETX (0x03)
1 Byte	10 Bytes	M Byte	1 Byte	1 Byte

HOST_to_RDR_XfrBlock Format

Offset	Field	Size	Value	Description
0	bMessageType	1	6Fh	
1	dDwLength <LSB .. MSB>	4	M	Message-specific data length
5	bSlot	1	00-FFh	Identifies the slot number for this command. Default=00h
6	bSeq	1	00-FFh	Sequence number for command
7	bBWI	1	00-FFh	Used to extend the Block Waiting Timeout.
8	wLevelParameter	2	0000h	

ACR122S Response Frame Format

STX (0x02)	Bulk-IN Header (RDR_to_HOST_DataBlock)	abData	Checksum	ETX (0x03)
1 Byte	10 Bytes	N Bytes (ATR)	1 Byte	1 Byte

RDR_to_HOST_DataBlock Format

Offset	Field	Size	Value	Description
0	bMessageType	1	80h	Indicates that a data block is being sent from the ACR122S
1	dwLength <LSB .. MSB>	4	N	Size of abData field. (N Bytes)
5	bSlot	1	Same as Bulk-OUT	Identifies the slot number for this command
6	bSeq	1	Same as Bulk-OUT	Sequence number for corresponding command
7	bStatus	1		
8	bError	1		
9	bChainParameter	1		

Example 1. To send an APDU "80 84 00 00 08" to the slot 0 (default), sequence number = 3.

HOST -> 02 6F 05 00 00 00 00 03 00 00 00 80 84 00 00 08 [Checksum] 03
RDR -> 02 00 00 03
RDR -> 02 80 0A 00 00 00 00 03 00 00 00 E3 51 B0 FC 88 AA 2D 18 90 00 [Checksum] 03
Response = E3 51 B0 FC 88 AA 2D 18; SW1 SW2 = 90 00

Warning:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
   (1) This device may not cause harmful interference, and
   (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority operate the equipment.