SEED TECHNOLOGY INC (SEEEDUINO)
NFC Shield
Model: SLD80453P

Introduction

NFC Shield is a Near Field Communication interface for **Arduino** build around the popular **NXP PN532** integrated circuit. **NFC** is a *short-distance* radio technology that enables communication between devices that are held close together. NFC traces its roots in **RFID** technology and is an open platform technology standardized in **ECMA-340** and **ISO/IEC 18092**.

NFC is widely used like **RFID** to recognize cards/tags (NXP Mifare Cards / Tags). NFC can be used as an alternative to **travel card** using the read/write memory provided by cards/tags. Few mobile phones comes with NFC inbuilt - they are used as readers of cards, tags, smart posters with a Web URL(like a Mobile QR-Code reader). This technology is also being applied for **smart cashless purchases**.

Like many other standards, NFC technology is regulated by **Near Field Communication Forum** which standardizes **NFC** communication -- how they devices pair, share data and allow a secure transaction to happen.NFC Forum develops and certifies devices compliant with **NFC standards**.

NFC operate on unlicensed ISM(Industry Scientific Medical) band of **13.56 MHz** Frequency. NFC communication range is up to 10 cm. But, this is limited by the antenna and power radiation design. Most devices work within a range of 10mm. **NFC Shield** antenna is designed to work within a range of 1cm. **NFC Shield** provides all necessary circuitry for **PN532** like 27.12Mhz crystal, power supply.It also beaks-out the I/O pins of **PN532** for easy access.

The communication between **Arduino** and **NFC Shield** is via **SPI**.

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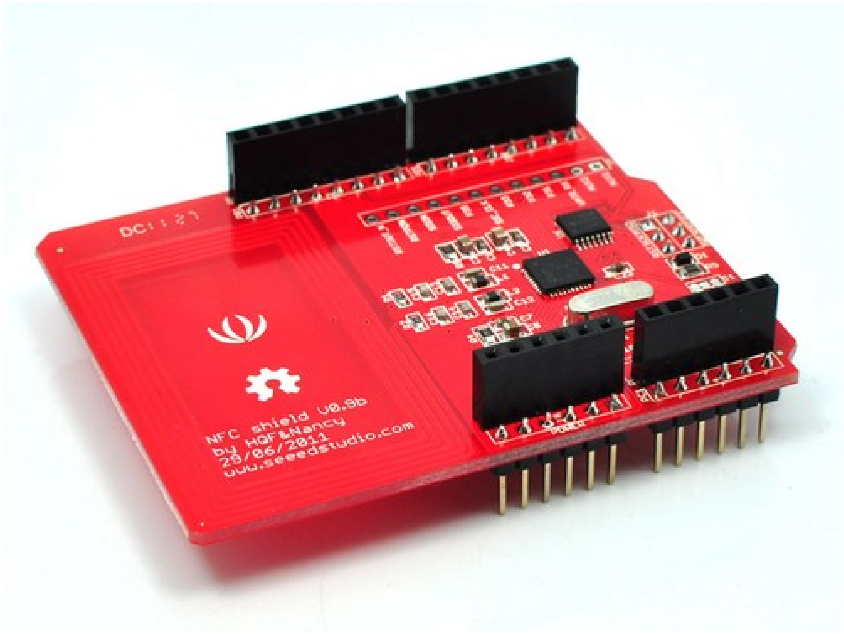


Features

- Arduino Shield compatible. No soldering required.
- **SPI** interface. Hence, most **Arduino** pins are available for other applications.
- Built in **PCB Antenna**.
- Supports both 3.3V and 5V operation using TI's **TXB0104** level translator.
- Socket to connect other shields.
- The maximum communication range of this NFC Shield is about 5 cm

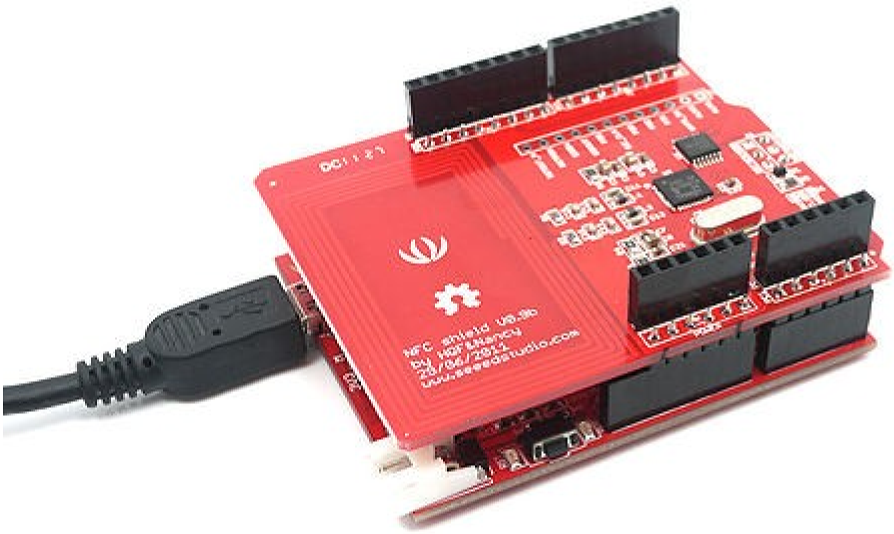
Application Ideas

- Use as a RFID reader with **Mifare One tags** (ISO14443 Type-A) and cards (13.56Mhz).
- Build visiting card sharing system.
- Build attendance systems.
- Design authentication systems.
- Read Smart Posters.
- Securely exchange small data with other NFC devices
- Use with Seeeduino ADK Main Board for creating mobile NFC applications.
- And other endless possibility.

Usage

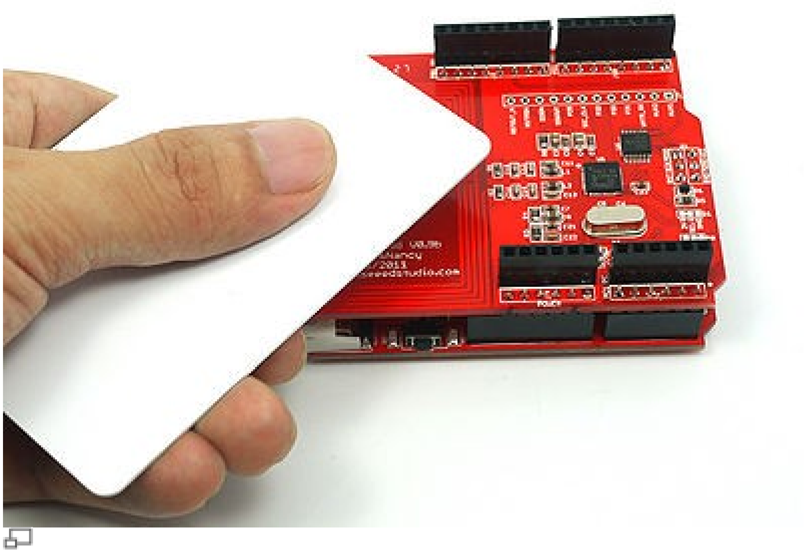
Hardware Installation

- Set **Seeeduino** power selection slide-switch to **3.3V**.
- Connect **NFC Shield** to **Seeeduino** as shown below.
- Compile and upload the example sketch provided.



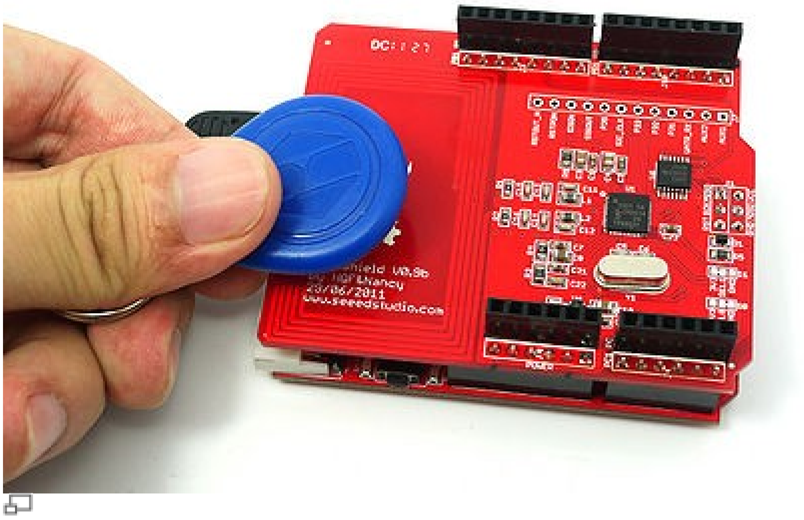
NFC Shield - Connected to Seeeduino

- Hold the **MIFARE Card** near the antenna. The NFC Shield will read the passive id data.



Mifare Card held near NFC Shield Antenna

- Hold the **MIFARE Tag** near the antenna. The NFC Shield will read the passive id data.



Mifare Tag held near NFC Shield Antenna

Programming

The PN532 software library for **NFC Shield** is derived from Adafruits PN532 Library.The original library provides API for reading Passive Target ID of Mifare Card/Tags. This is enough for card/tag identification purpose. We have added APIs for authentication, reading from and writing to Mifare Cards/Tags. The software library only provides low level functionality. Users have to implement NFC application layer(if required).

Quick Start Demo

A simple sketch which reads the **Passive Target ID** from MIFARE cards and tags. **Passive Target ID** is an **unique**, **permanent** and **read-only** number programmed on to the MIFARE card by the manufacturer. This number is used to identify one card from another.

- Connect the NFC Shield to Seeeduino / Arduino as shown above.
- Compile and upload the program to Arduino.
- Bring a Mifare Card near the NFC Antenna as shown above.

```
#include <PN532.h>

/*
 * Corrected MISO/MOSI/SCK for Mega from Jonathan Hogg (www.jonathanhogg.com)
 * SS is the same, due to NFC Shield schematic
 */
#define SS 10
#if defined(__AVR_ATmega1280__) || defined(__AVR_ATmega2560__)
  #define MISO 50
  #define MOSI 51
  #define SCK 52
#else
  #define MISO 12
  #define MOSI 11
  #define SCK 13
#endif

PN532 nfc(SCK, MISO, MOSI, SS);

void setup(void) {
  Serial.begin(9600);

  nfc.begin();

  uint32_t versiondata = nfc.getFirmwareVersion();
  if (! versiondata) {
    Serial.print("Didn't find PN53x board");
    while (1); // halt
  }
  // Got ok data, print it out!
  Serial.print("Found chip PN5"); Serial.println((versiondata>>24) & 0xFF, HEX);
  Serial.print("Firmware ver. "); Serial.print((versiondata>>16) & 0xFF, DEC);
  Serial.print('.'); Serial.println((versiondata>>8) & 0xFF, DEC);
  Serial.print("Supports "); Serial.println(versiondata & 0xFF, HEX);

  // configure board to read RFID tags and cards
  nfc.SAMConfig();
}


void loop(void) {
  uint32_t id;
  // look for MiFare type cards
  id = nfc.readPassiveTargetID(PN532_MIFARE_ISO14443A);
  if (id != 0) {
    Serial.print("Read card #"); Serial.println(id);
  }
}
```

Application Programming Interfaces

NFC is a secure technology (*Meaning*: *Communication between NFC reader/writer and NFC card/tag happens in a encrypted and authenticated manner*). The security and other complex handshaking are handled by PN532 firmware provided by NXP.

The APIs make use of the commands to invoke the interfaces provided by PN532 firmware via SPI. All these commands are documented in PN532 User Manual. The following APIs are provided by PN532 Library.

PN532(uint8_t cs, uint8_t clk, uint8_t mosi, uint8_t miso)

An object of PN532() is created with this. The digital pins of Arduino used as SPI (in AtMega328P or Mega) is specified as parameters.

Usage:

```
#define SCK 13
#define MOSI 11
#define SS 10
#define MISO 12

PN532 nfc(SCK, MISO, MOSI, SS);
```

begin()

begin() method has to be called to initialize the driver.

Usage:

```
nfc.begin();
```

boolean SAMConfig(void)

This API invokes the **SAMConfiguration** command of PN532 and sets it to **Normal Mode**. **SAM** stands for Security Access Module (i.e the PN532 system). PN532 system can work in **Normal** mode, **Virtual Card** mode, **Wired Card** mode and **Dual Card** mode.

Usage:

```
nfc.SAMConfig(); // Call this before any read/write operation
```

uint32_t readPassiveTargetID(uint8_t cardbaudrate)

This method reads the Passive Target ID and returns it as a 32-bit number. At the moment only reading MIFARE ISO14443A cards/tags are supported. Hence use **PN532_MIFARE_ISO14443A** as parameter. *Returns* 32 bit card number

Usage:

```
uint32_t cid;
// look for MiFare type cards/tags
cid = nfc.readPassiveTargetID(PN532_MIFARE_ISO14443A);
```

*uint32_t authenticateBlock(uint8_t cardnumber, uint32_t cid, uint8_t blockaddress ,uint8_t authtype, uint8_t * keys)*

This method is used to authenticate a memory block with key before read/write operation. *Returns* **true** when successful.

- **cardnumber** can be 1 or 2
- **cid** is 32-bit Card ID
- **blockaddress** is block number (any number between 0 - 63 for MIFARE card)
- **authtype** is which key is to be used for authentication (either **KEY_A** or **KEY_B**)
- **keys** points to the byte-array holding 6 keys.

Usage:

```
uint8_t keys[]= {0xFF,0xFF,0xFF,0xFF,0xFF,0xFF};  // default key of a fresh card
nfc.authenticateBlock(1, id ,3,KEY_A,keys); ////authenticate block 3, id is 32-bit passive
target id.
```

uint32_t readMemoryBlock(uint8_t cardnumber,uint8_t blockaddress, uint8_t * block)

This method reads a memory block after authentication with the key. *Returns* **true** when successful.

- **cardnumber** can be 1 or 2
- **blockaddress** is block number (any number between 0 - 63 for MIFARE card) to read. Each block is 16bytes long in case of MIFARE Standard card.
- **block** points to buffer(byte-array)to hold 16 bytes of block-data.

Usage:

```
uint8_t block[16];
nfc.readMemoryBlock(1,3,block); //Read can be performed only when authentication was
successful.
```

uint32_t writeMemoryBlock(uint8_t cardnumber,uint8_t blockaddress, uint8_t * block)

This method writes data to a memory block after authentication with the key. *Returns* **true** when successful.

- **cardnumber** can be 1 or 2
- **blockaddress** is block number (any number between 0 - 63 for MIFARE card) to write. Each block is 16bytes long in case of MIFARE Standard card.
- **block** points to buffer(byte-array) which holds 16 bytes of block-data to write.

Usage:

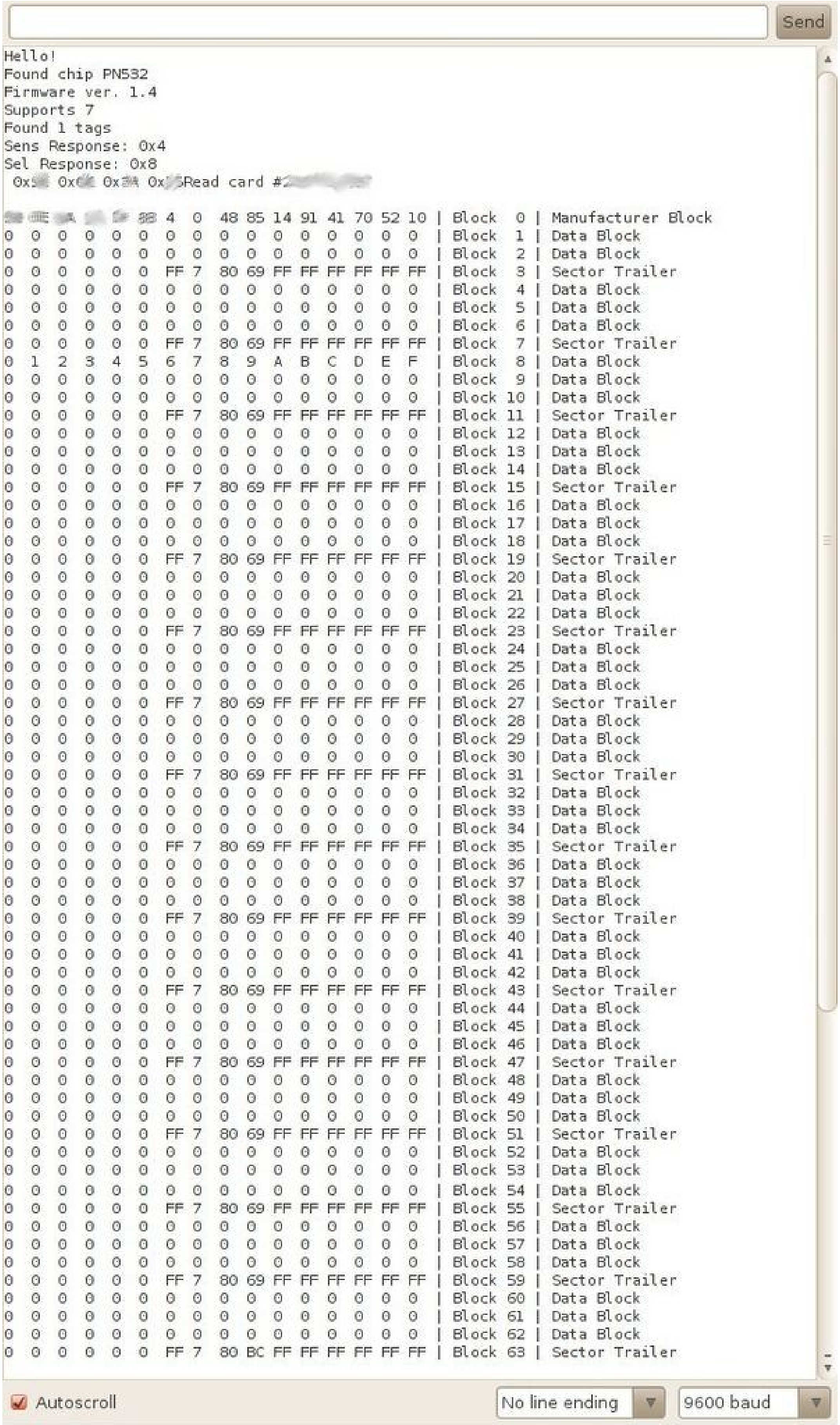
```
uint8_t writeBuffer[16];
    for(uint8_t ii=0;ii<16;ii++)
     {
       writeBuffer[ii]=ii; //Fill buffer with 0,1,2....F
     }
nfc.writeMemoryBlock(1,0x08,writeBuffer); //Write writeBuffer[] to block address 0x08. Read
can be performed only when authentication was successful.
```

readAllMemoryBlocks.pde

Compile and upload **readAllMemoryBlocks.pde** example provided with the library. This sketch reads the complete memory of a MIFARE Standard card using default authentication keys. The output gives typical memory layout of fresh MIFARE Standard card.

Blocks are classified as **Manufacturer Block**(read-only), **Data Block** (user/application writable area), and **Sector Trailer**(authentication and access bits for that sector)

Output



```
Hello!
Found chip PN532
Firmware ver. 1.4
Supports 7
Found 1 tags
Sens Response: 0x4
Sel Response: 0x8
 0x[redacted] 0x[redacted] 0x[redacted] 0x[redacted]Read card #[redacted]

[redacted] 4  0  48 85 14 91 41 70 52 10 | Block  0 | Manufacturer Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block  1 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block  2 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block  3 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block  4 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block  5 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block  6 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block  7 | Sector Trailer
0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F  | Block  8 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block  9 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 10 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 11 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 12 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 13 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 14 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 15 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 16 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 17 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 18 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 19 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 20 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 21 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 22 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 23 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 24 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 25 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 26 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 27 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 28 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 29 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 30 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 31 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 32 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 33 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 34 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 35 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 36 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 37 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 38 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 39 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 40 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 41 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 42 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 43 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 44 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 45 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 46 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 47 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 48 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 49 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 50 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 51 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 52 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 53 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 54 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 55 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 56 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 57 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 58 | Data Block
0  0  0  0  0  0  FF 7  80 69 FF FF FF FF FF FF | Block 59 | Sector Trailer
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 60 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 61 | Data Block
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  | Block 62 | Data Block
0  0  0  0  0  0  FF 7  80 BC FF FF FF FF FF FF | Block 63 | Sector Trailer
```

☑ Autoscroll

No line ending ▼

9600 baud ▼

Support

Ask questions on Seeed forum.

Version Tracker

Revision	Descriptions	Release
v0.9b	Initial public release	4,Aug,2011

Resources

- Arduino Lib for NFC Shield
- NFC Shield - Schematic and Board Files in Eagle Format
- NFC Shield - Schematic in PDF format
- NXP PN532 - User Manual
- NXP Mifare One S50 IC
- NFC Forum

How to buy

- Click here to buy NFC Shield from Seeedstudio Bazaar.

See Also

- Mifare-One RFID Tag (13.56MHz)
- Mifare - One RFID card (13.56Mhz)
- Seeeduino V2.2
- Seeeduino ADK Main Board

Licensing