HITBSecConf

Wireless Hacking with HackCUBE& HackCUBE-Special

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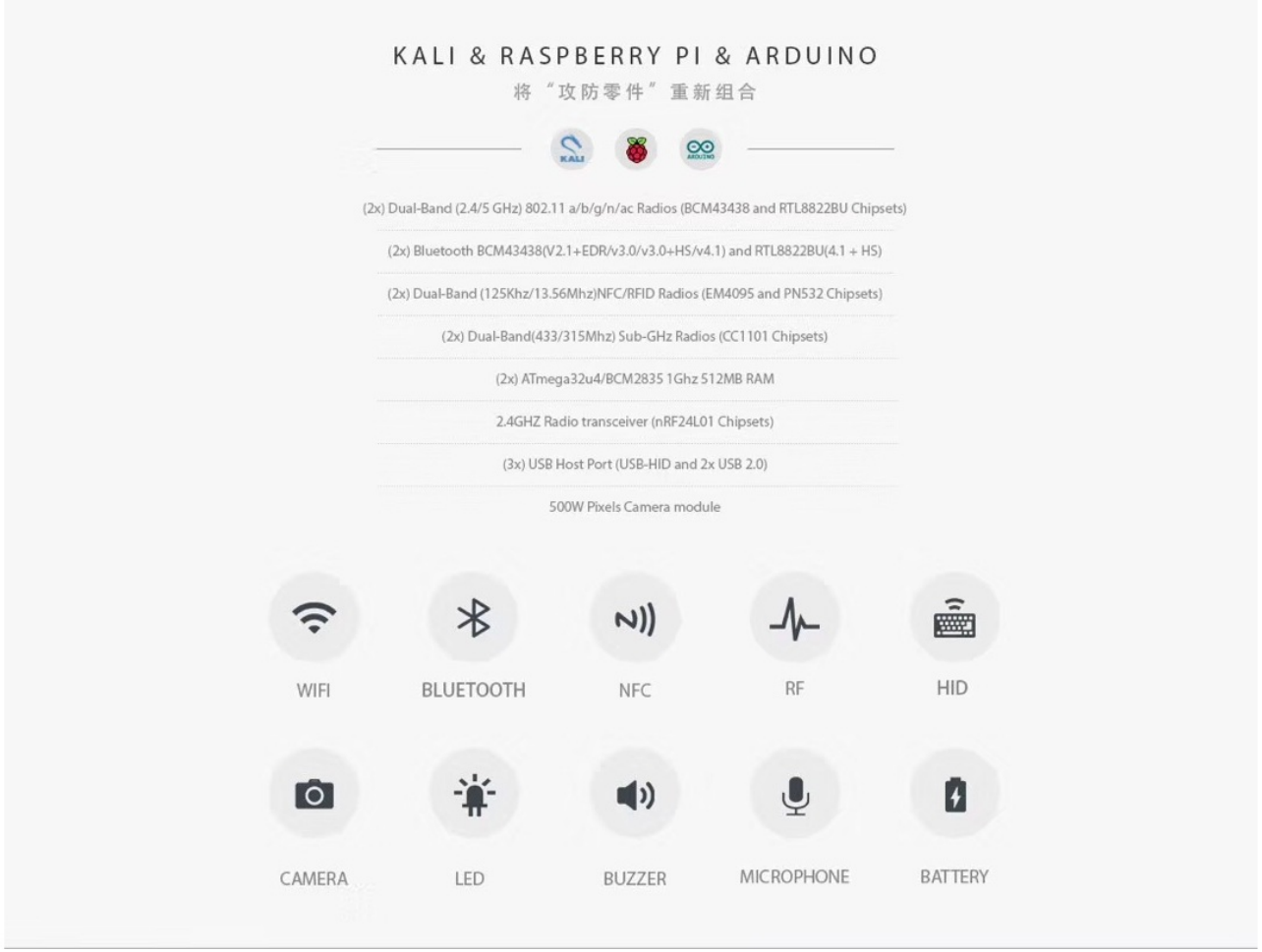
From PegasusTeam

Brief introduction of HackCUBE



防御

抵御无线射频攻击
根据频谱仪溯源恶意干扰源
有效防御汽车中继攻击
可阻断未知射频信号

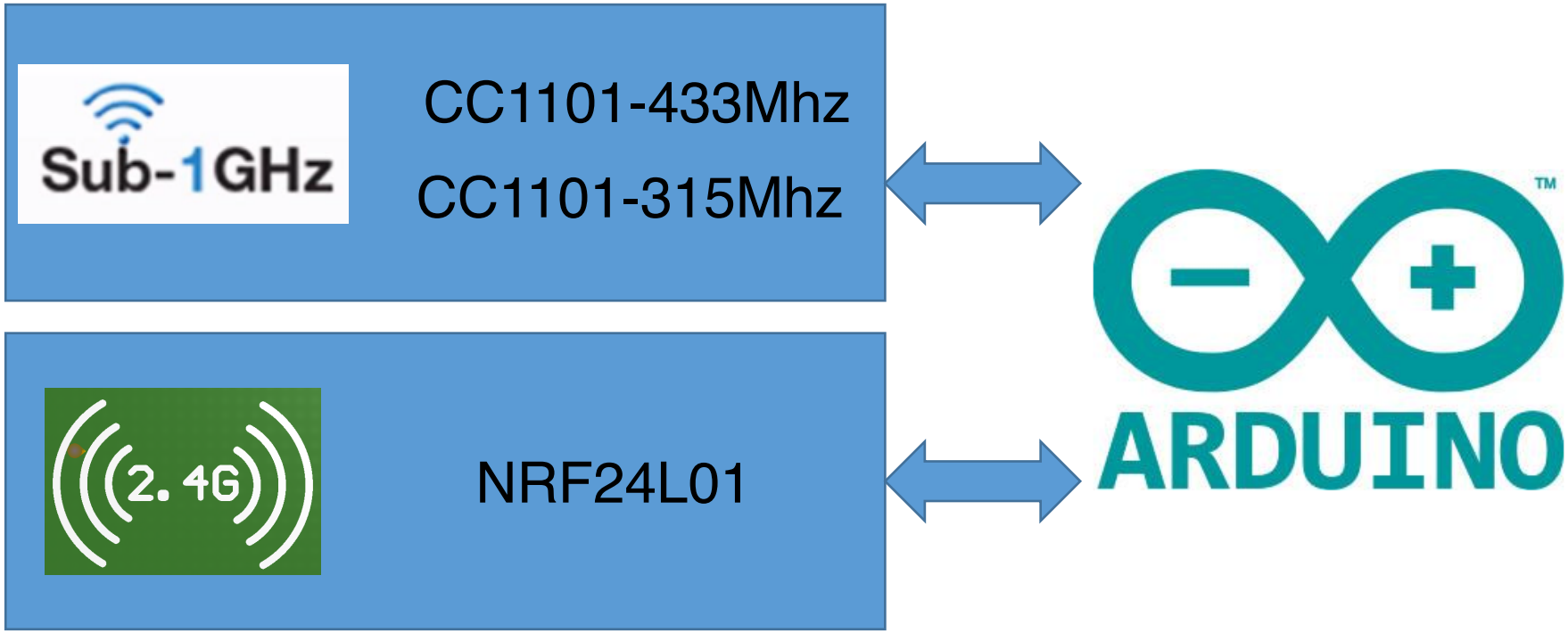
Two specific attack cases

Fixed-code brute force attack to parking bar

Attack to Entrance guard system

Example 1:
Fixed-code brute force attack to parking bar

Resources of HackCUBE for attacking Sub-1Ghz & 2.4GH



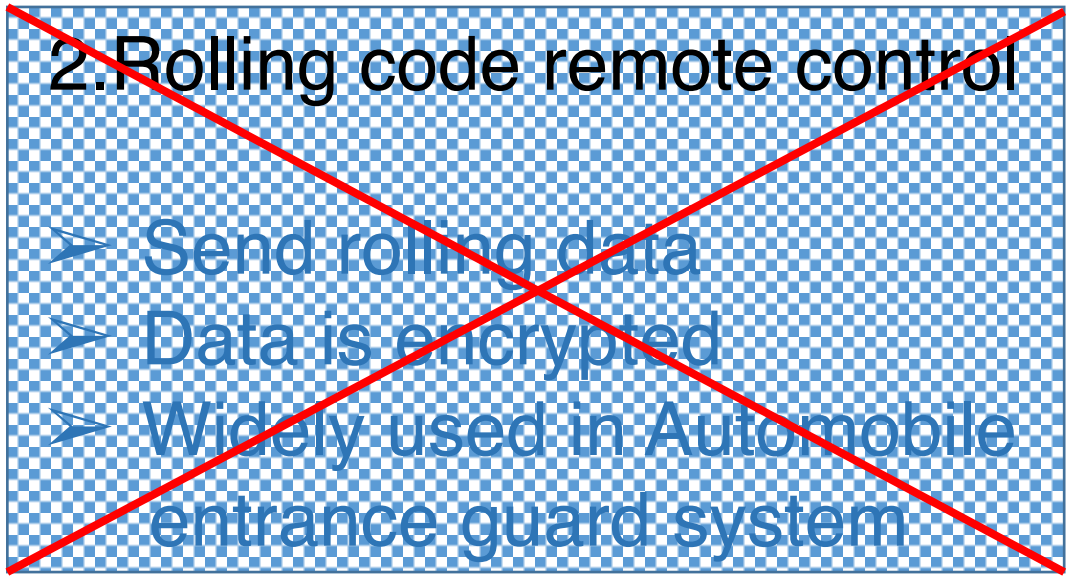
Sub-1GHz radio usage in our daily life

2.4GHz Radio usage in our daily life

Basic knowledge of Remote Keyless Entry

1.Fixed code remote control

- ➢ Send same data every time
- ➢ Data is not encrypted
- ➢ Widely used in
  - Safety Guard System
  - Smart Home System

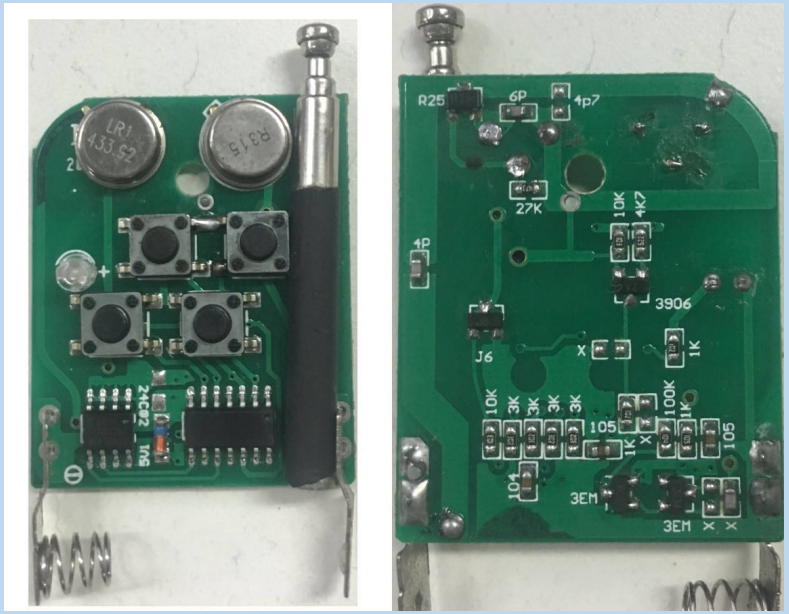


If you are interested in the Rolling code remote control, please refer to https://www.youtube.com/watch?v=p3SJp-7LSNs&t=2807s

Two types of Fixed code remote control

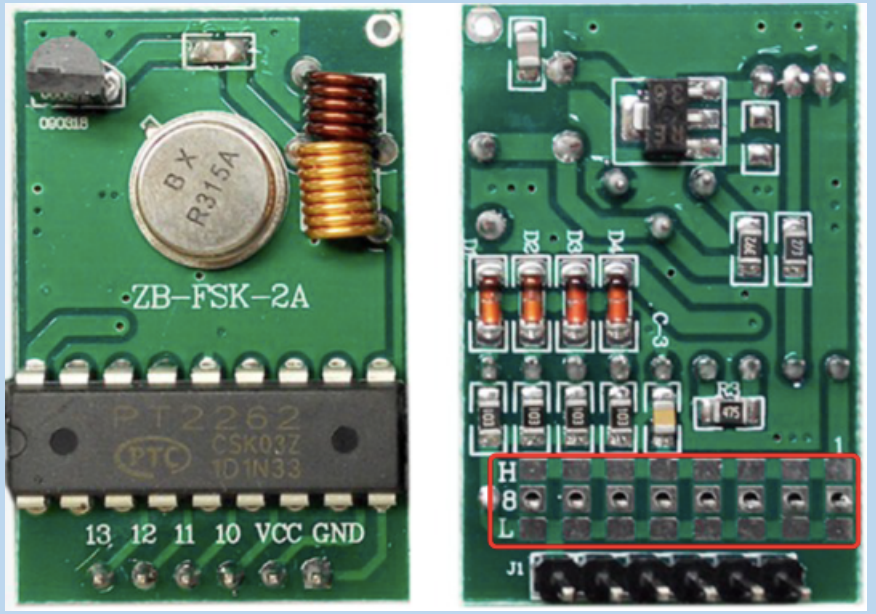
1.Changeless coding

address is fixed by the Semiconductor manufacturer



2. Changeable coding

can change address by soldering to 3 different states



How to attack the parking bar?

In fact , the parking bar system is a fixed-code remote control.

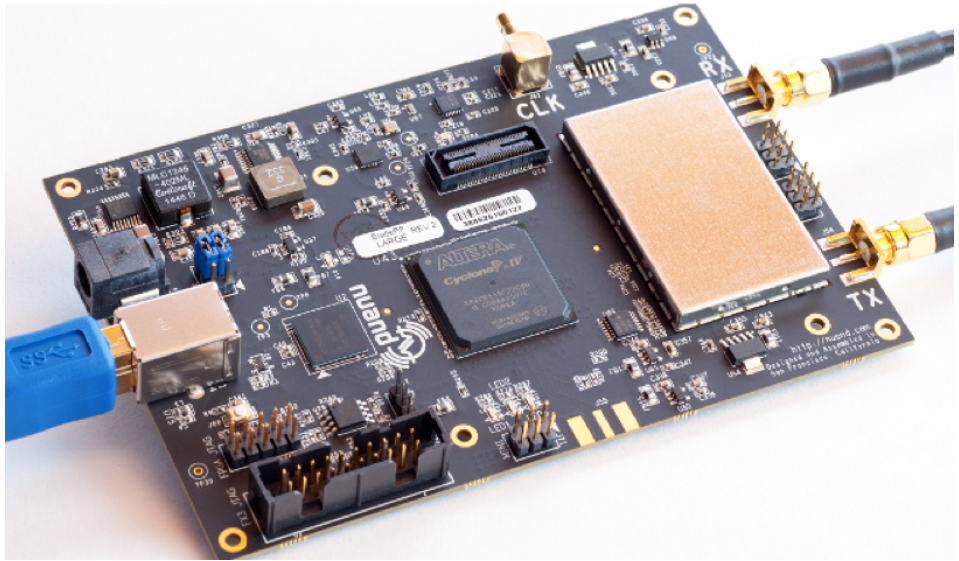
Method 1:
Sniff the signal when the guard control the parking bar,
then replay it using the HackCUBE or any other SDR tools.

Method 2:
Reverse analysis signal, then forge all the data.

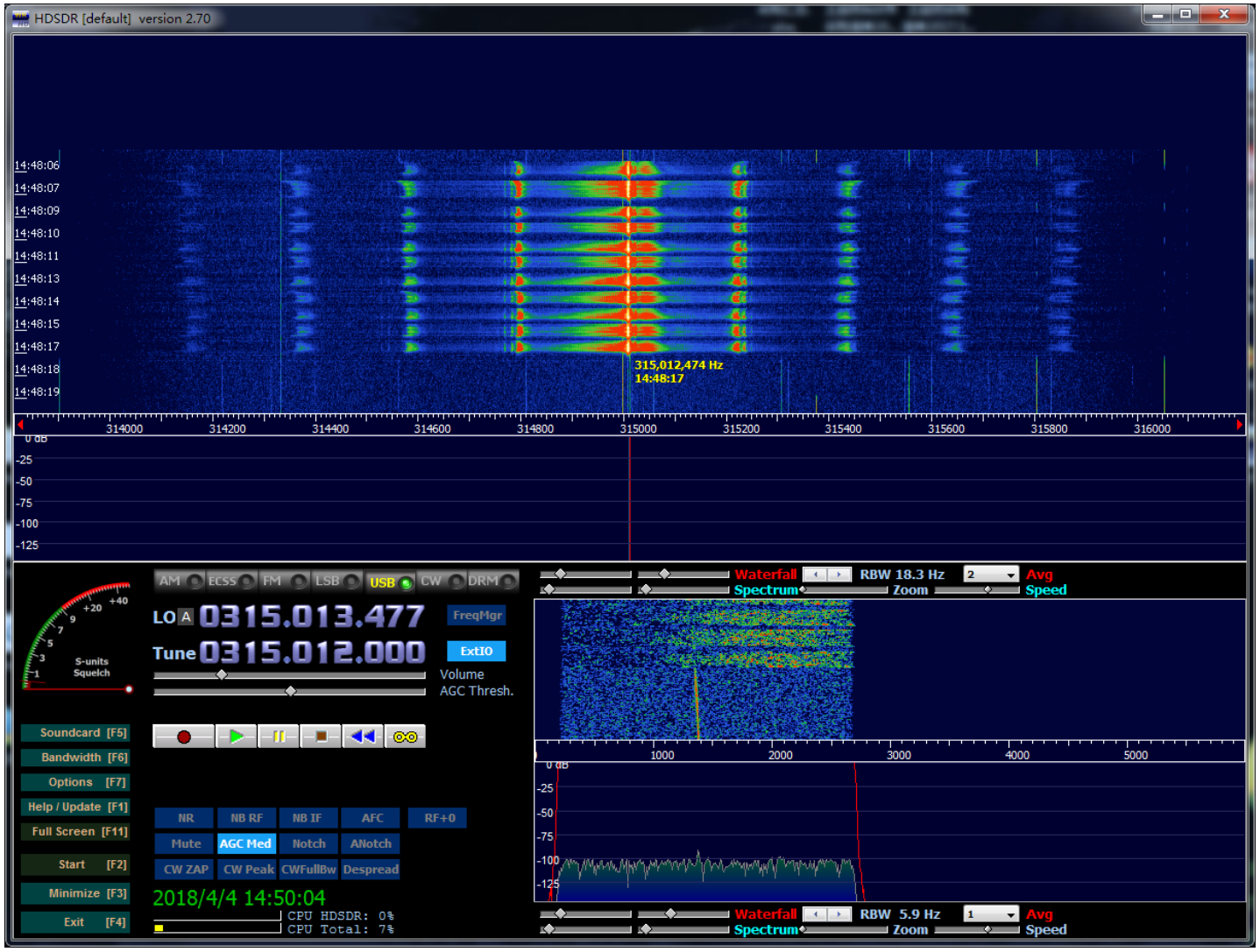
How to find the operating frequency?

HackRF USRP

BladeRF RTL2832U

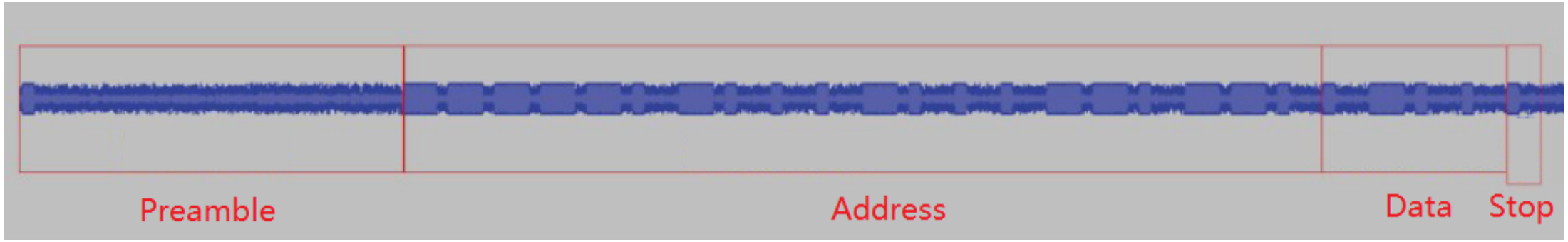


The frequency is 315MHz



Analyzing the signal--Changeless coding

The original signal



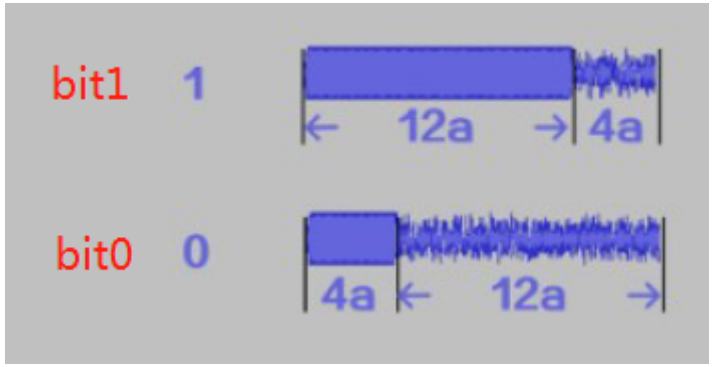
The signal can be divided into 4 parts

Preamble: used by receiver to sync with the transmitter
Address: Identification code
Data: function code
Stop: stop bit

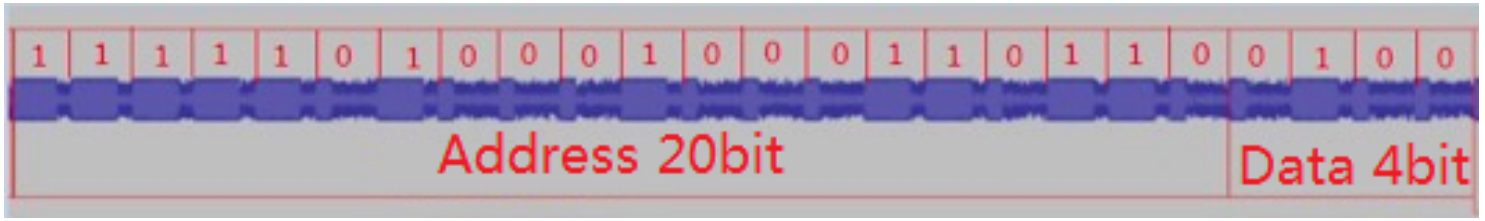
Decoding the signal--Changeless coding

The original signal

Coding format

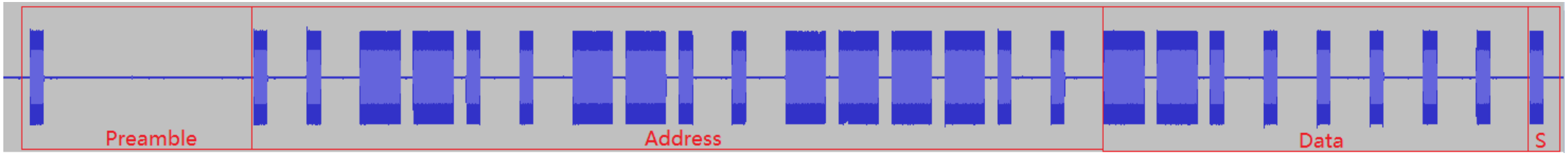


Decoded data



Analyzing the signal--Changeable coding

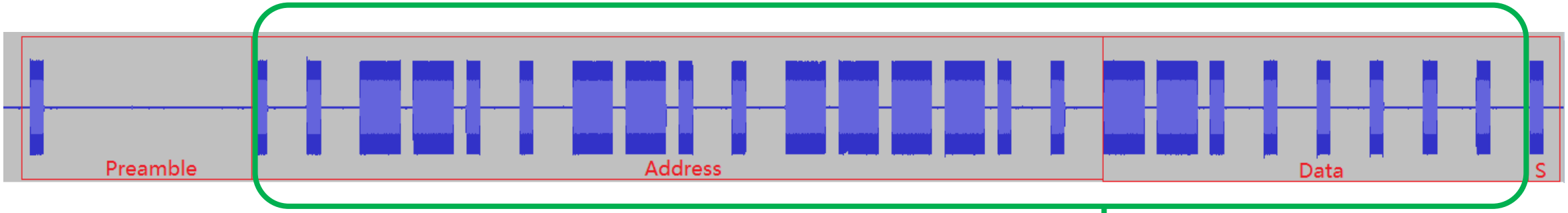
The original signal



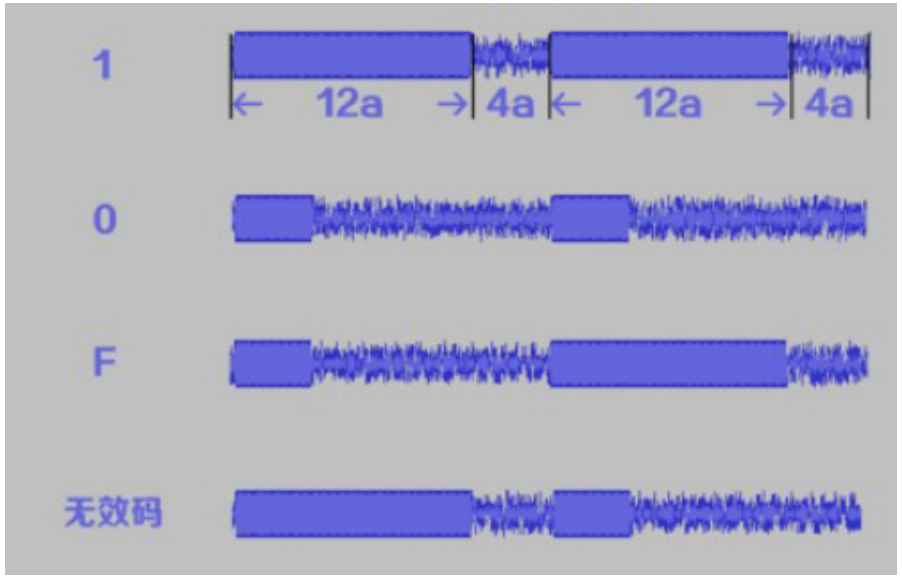
The signal can be divided into 4 parts:

Preamble: used by receiver to sync with the transmitter
Address: Identification code
Data: function code
Stop: stop bit It is same as the changeless code.

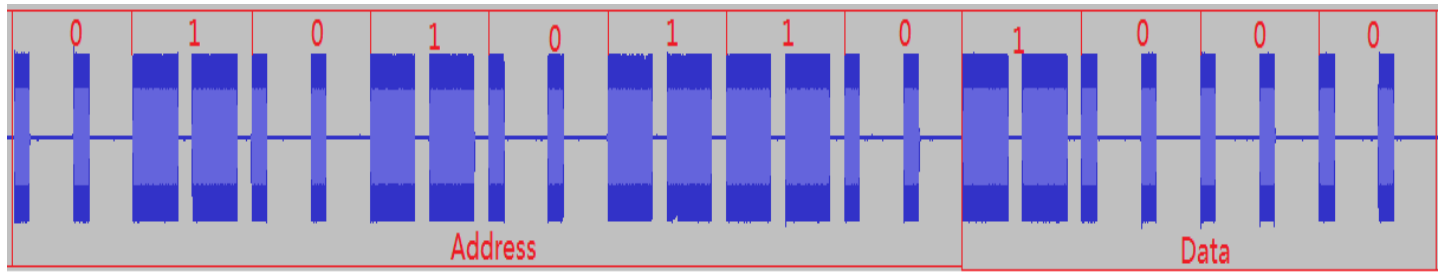
Decoding the signal--Changeable cod



Coding format



Decoded data



Changeable coding VS changeless coding

Changeable coding

1. 8 bit address & 3 states
   total numbers 3^8=6551

2. It take about 10 minute to carry out brute force attack

Changeless coding

1. 20 bit address & 2 states
   total numbers 2^20=1048576

2. It is not easy to carry out brute force attack

Get your hands dirty;)

Following the steps
Step1: Plug the MicroUSB to power the HackCUBE
Step2: Power the LEGO-based parking bar model
Step3: Connect to the AP of the HackCUBE
SSID: HackCUBE_xx:xx:xx (MAC address)
key: hackcube123
Step 4: open the browser, enter 192.168.2.3
Step5: select the RF tab
Step6: click the attack in bottom of this web

Example 2: attacking RFID

Resources of HackCUBE for attacking RFID

transceiver module for contactless communication at 13.56 MHz, 6 different operating modes:

1.ISO/IEC 14443A/MIFARE® Reader/Writer
2.FeliCa Reader/Writer
3.ISO/IEC 14443B Reader/Writer
4.ISO/IEC 14443A/MIFARE Card MIFARE Classic® 1K or MIFARE Classic 4K card emulation mode
5.FeliCa Card emulation

Read/Write analog front end for 125kHz RFID

Multiple transponder protocol compatibility (Ex: EM4102, EM4200, EM4450 and EM4205/EM4305)

RFID usage in our daily life

What can we do with the HackCUBE?

1. Read the 125Khz ID tag

2. Write to T5577 card with any card number
   from the stored card data or the inputted data

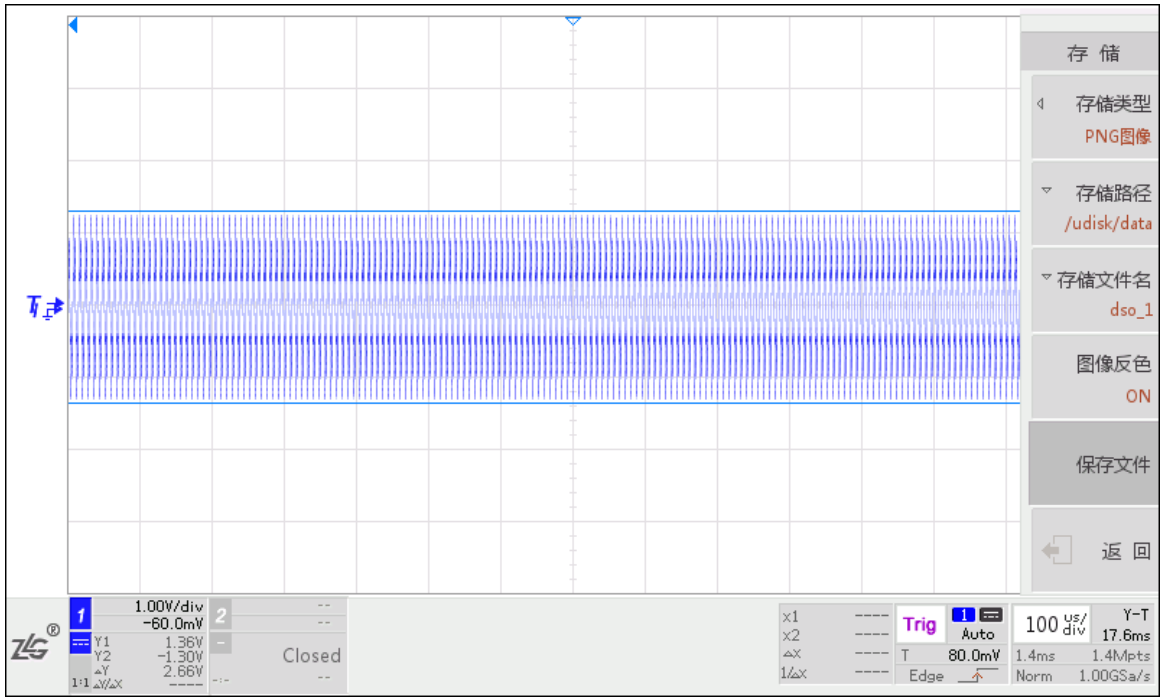
3. Emulate as cards with any card number
   from the stored card data or the inputted data

……

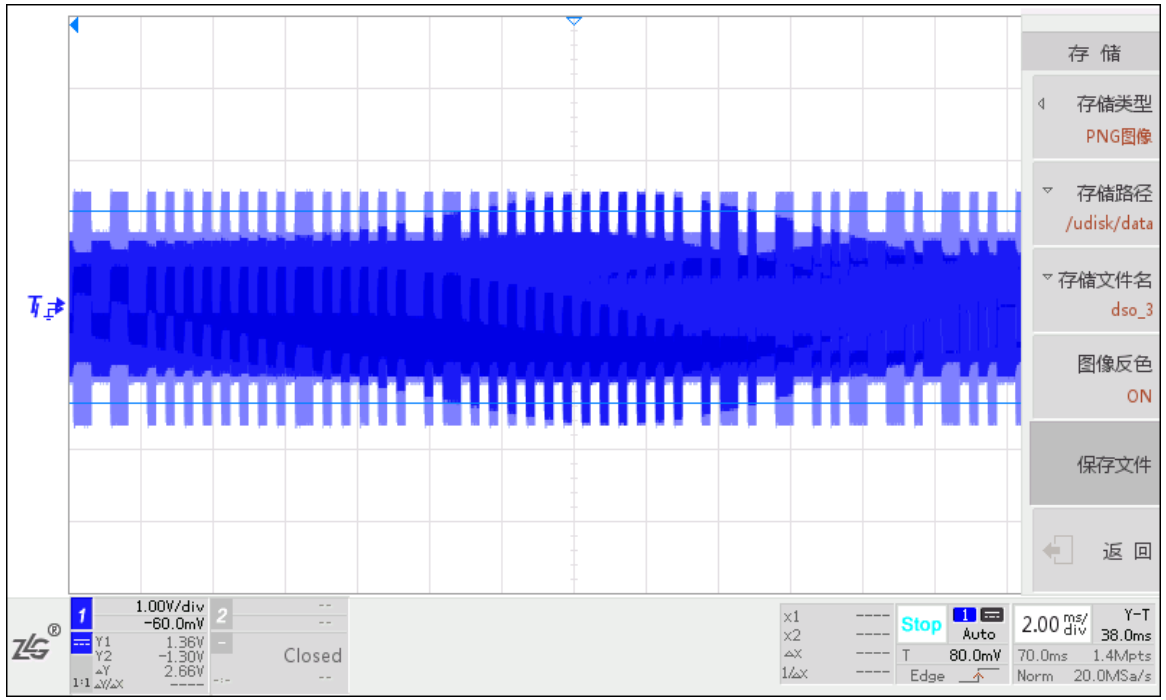
Any function you want to add which works at 125KHz

Read ID(125KHz) tag

Signal of the reader without any tag

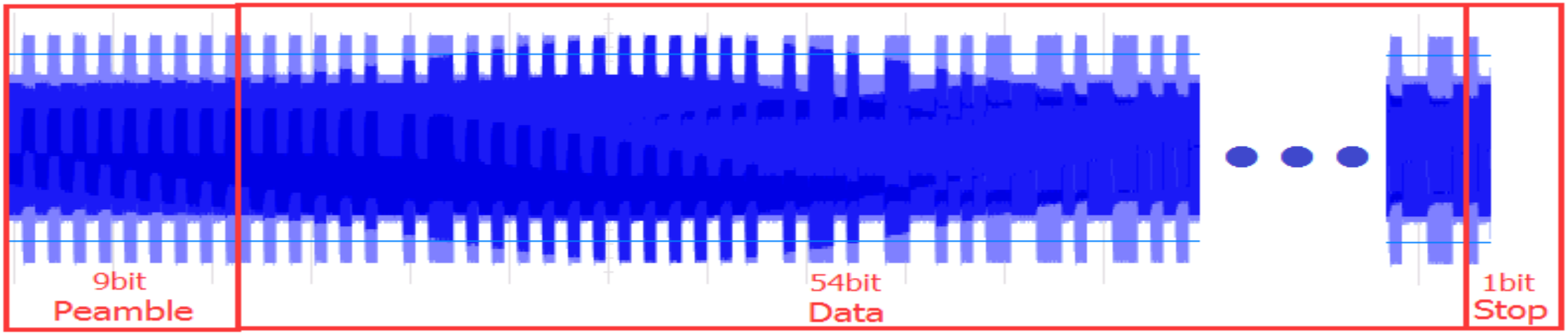


Put a tag close to the reader



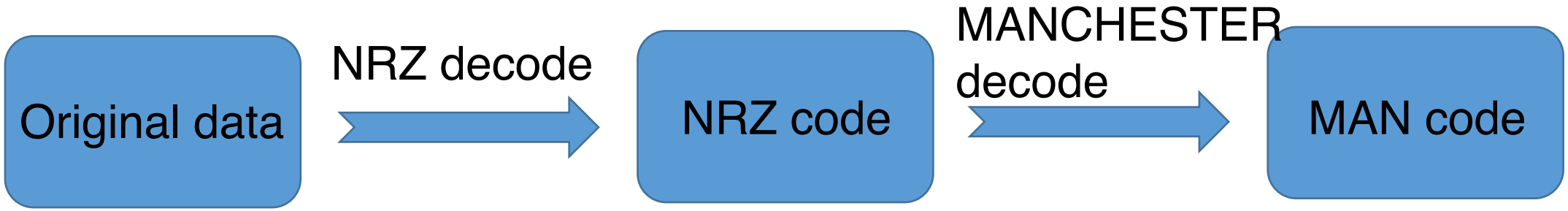
Analyzing the signal

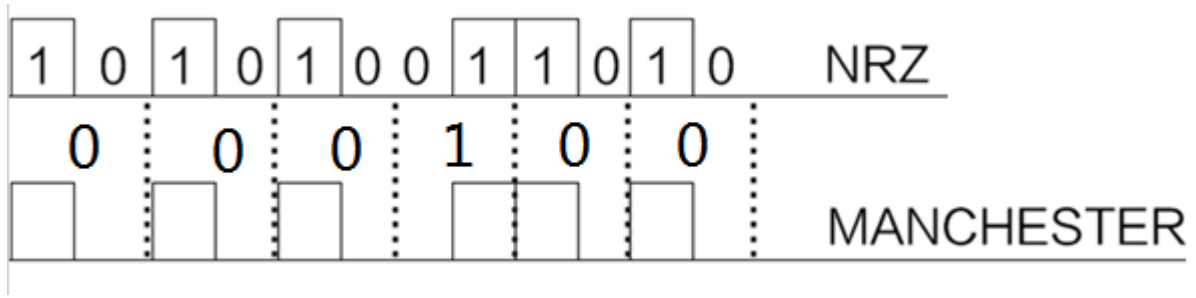
The original signal



The signal can be divided into 3 parts
Preamble: Consist of 9 bit1
Data: data + parity check
Stop: always bit0

Encoding format





NRZ decode 0101010101010101011010101010100101101010101010101010101010100101

MANCHESTER decode 1010011001010110011010011010100101100101010110011010010101100110

1111111110000001100000000000001100101110100100011011110100111010

1 1 1 1 1 1 1 1 1 1 x x x x R x x x x R x x x x R x x x x R x x x x R x x x x R x x x x R x x x x R L L L L S

Preamble VD ID ID ID ID check stop

Preamble : sync (9 bit1)

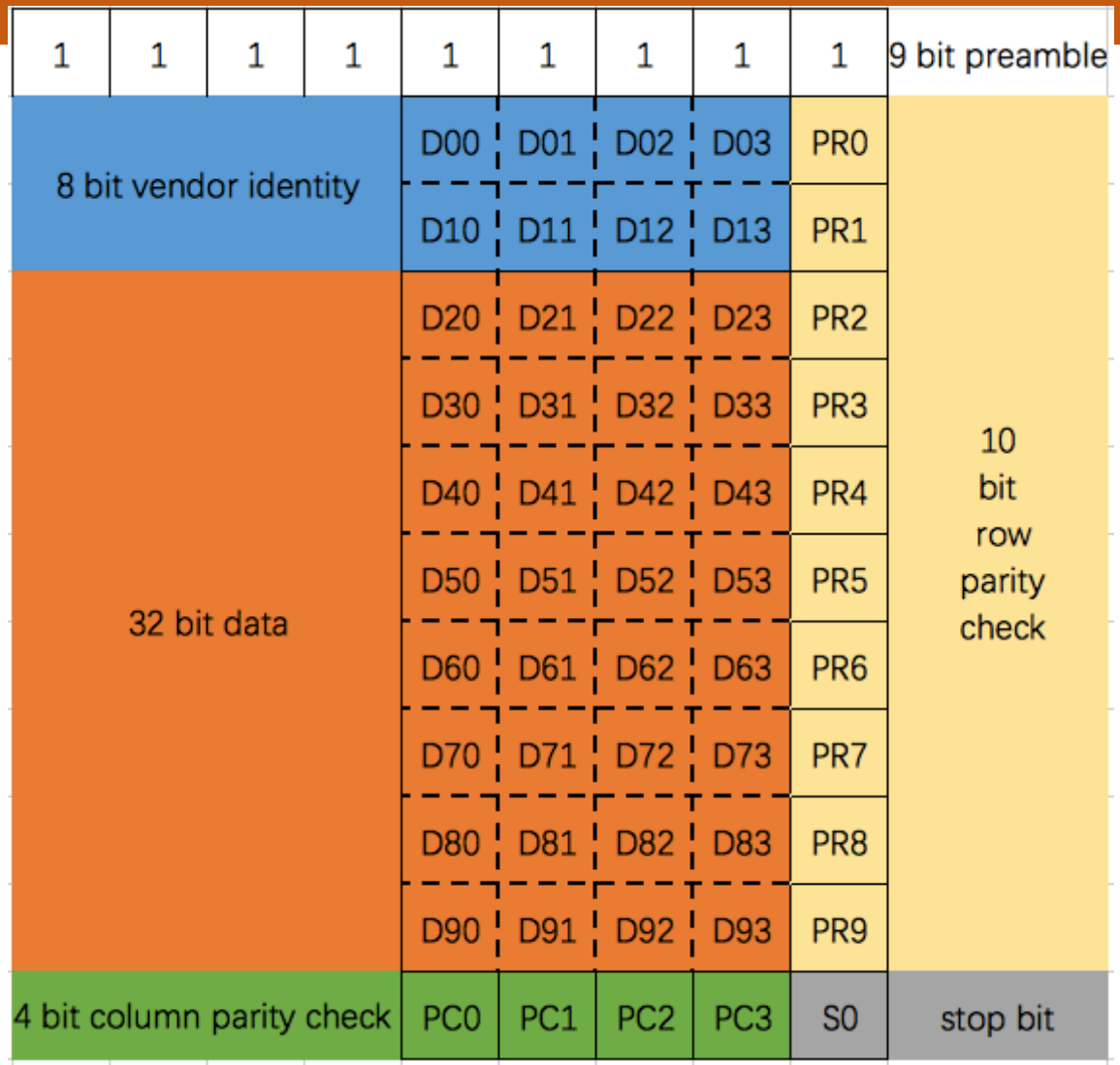
VD : vendor identity(8 bit)

ID : identity(32bit)

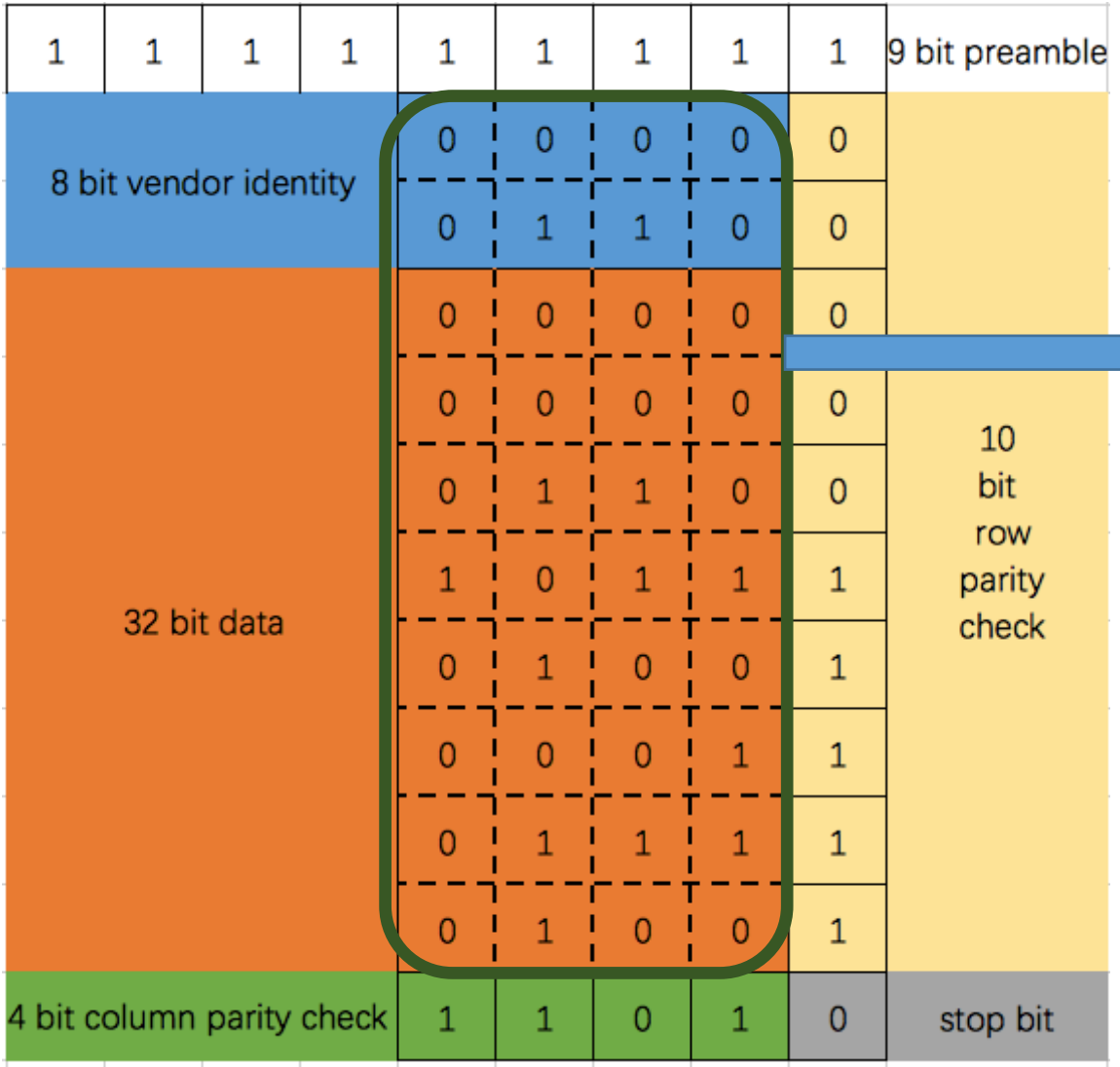
R : row parity check
(number of bit1 & 0x01)

L : column parity check
(number of bit1 & 0x01)

S : stop(bit0)



Get the tag number



Extract the VD & ID:
00000110
00000000
01101011
01000001
01110100
Tag : 06 00 6B 41 74

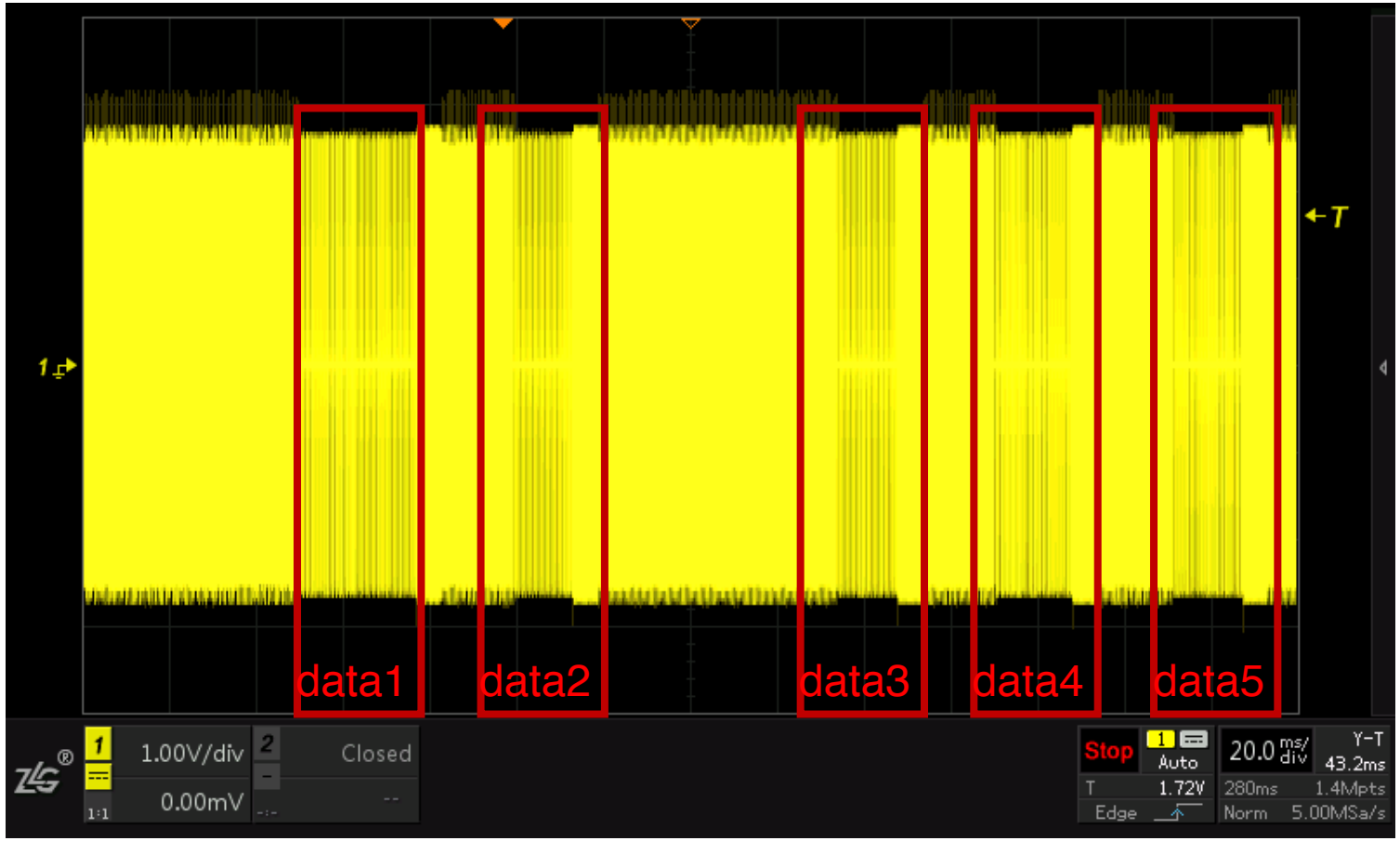
Emulate as ID(125KHz) tag

The protocol is similar to reading card
Just control the EM4095 chip as this protocol

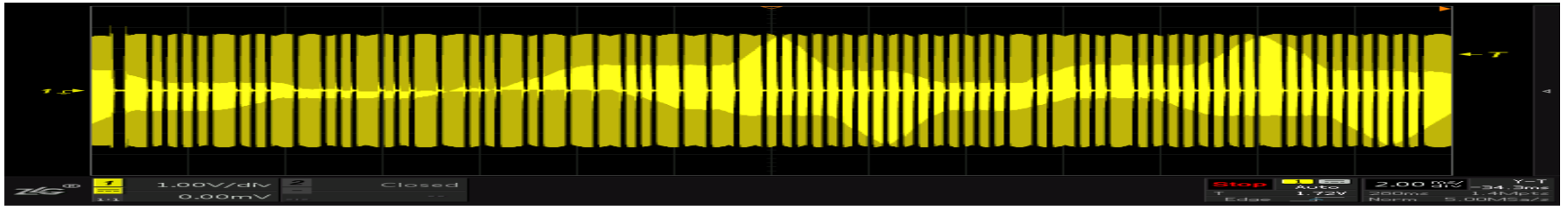
Warning : this emulation is a active emission, not similar to the real tag. It probably can’t be recognized by the reader.

Write ID(125KHz) tag

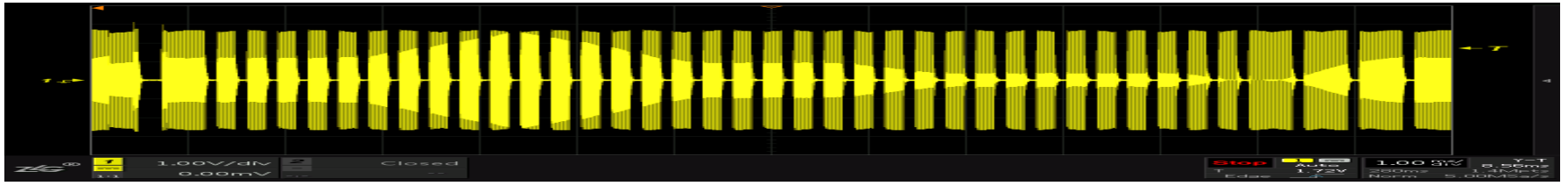
When we write to a writable tag, the captured signal is as the right picture



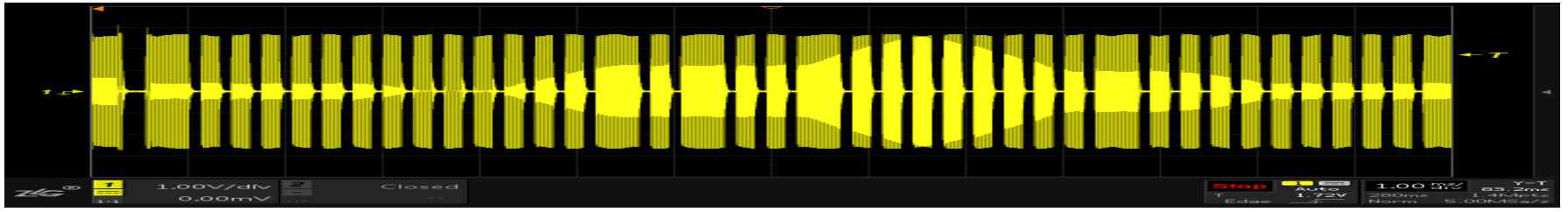
Details of the signal



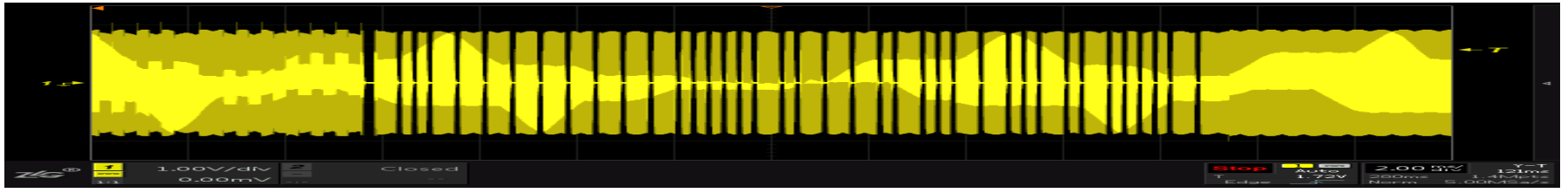
Data 1



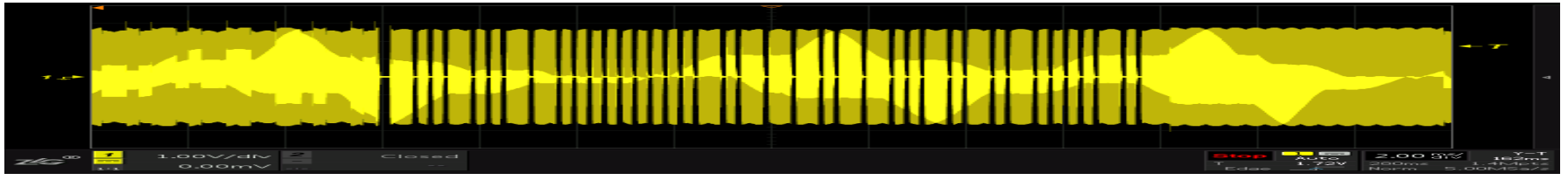
Data 2



Data 3



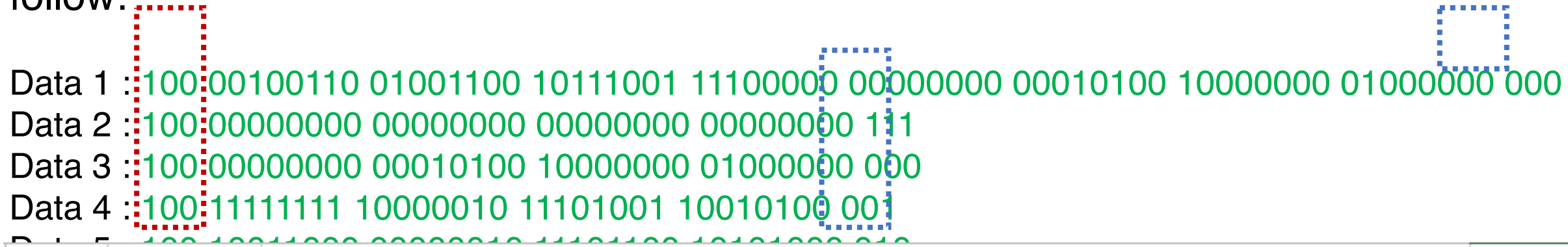
Data 4



Data 5

Decoding the signal

The wide signal is bit1, and the narrow signal is bit0.The 5 data can be decoded as follow:



signal	Preamble	data	address
Data1	100	00100110 01001100 10111001 11100000 00000000 00010100 10000000 01000000	000
Data2	100	00000000 00000000 00000000 00000000	111
Data3	100	00000000 00010100 10000000 01000000	000
Data4	100	11111111 10000010 11101001 10010100	001
Data5	100	10011000 00000010 11101100 10101000	010

The first 3 bits is the preamble

The last 3 bits is the writing address

The function of each signal

1.The first data is written to block 0, 0x264CB9E0 0x00148040, this is the configuration

2.The second data(0x00000000) is the password of the tag, which is written to block 7

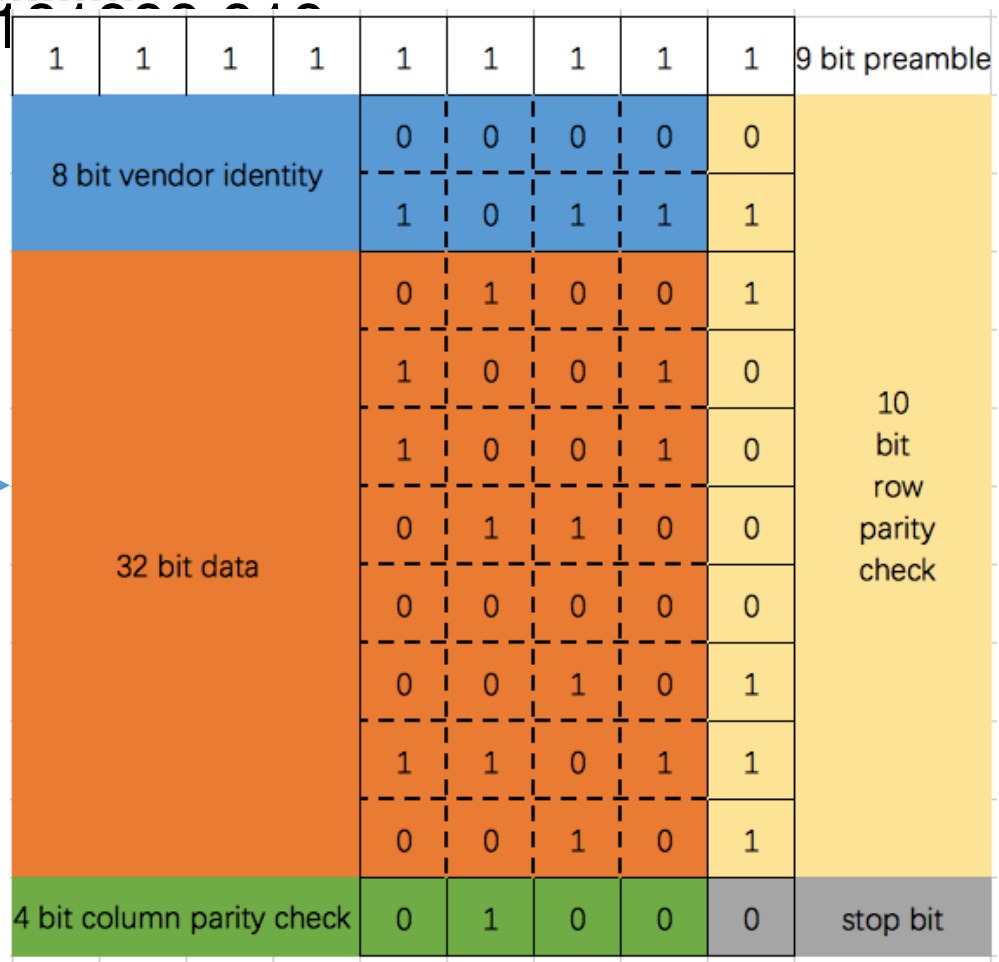
3.The third data(0x00148040) is also the configuration of the tag

4.The forth and fifth data is the data, which we want to written to the tag. The written address of the tag is block 1 and block 2

The data written to block 1 and block 2

Data 4 : 100 11111111 10000010 11101001 10010100 001

Data 5 : 100 10011000 00000010 11101100 101



After written the tag is
0x 0b 49 96 02 d2

Get your hands dirty;)

Following the steps
Step1: Plug the MicroUSB to power the HackCUBE-Special
Step2: Connect to the AP of the HackCUBE-Special
SSID: HackCUBE_xx:xx:xx (MAC address)
key: hackcube
Step3: open the browser, enter 192.168.5.1
Step4: select the NFC tab
Step5: put the tag close to the antenna of NFC
(opposite of the Logo)

Then you can find the reading tag on the web.

LF RF HID Setup

HackCUBE-Special LF

RFID Low Freqency System(125Khz,EM41XX&T5577) Risk Evaluation

Read ID

VID	ID	Simulate

Emulate ID(Test)

VID ID

Write ID

Write

VID ID

Brute Attack(Test)

VD Start ID End ID

VD Start ID Stop ID

LF RF HID Setup

HackCUBE-Special HID

Human Interface Device Risk Evaluation

Load Script

Key

Submit

List Script

info	name	run
29d172a6	lock	execute
d2f392f1	cmatrix	execute
9209993f	Shellcode	execute

LF RF HID Setup

HackCUBE-Special RF

Wireless System
(2.4Ghz,315Mhz&433Mhz&868/915Mhz) Risk Evaluation

Sniffer Data

Freq	Pac	Modu	Func	Data	Play

Transmit Data

Start

Freq: 315Mhz

Protocol: PT226X

Data: Data

Func: Func

Transmit Brute

Freq: 315Mhz

Protocol: PT226X

Start: Start address

End: Stop address

Func: Func

LF RF HID Setup

NFC Power RF Power

Frequency Setting: 315000000

Protocol: 固定码

Settings Update

Lighting Effects: ...

Lighting Colours: #ffffff

Lighting Brightness

128

效果更新

HACKNOWN

低频安全

门禁卡数据读取

Any questions?

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Thank you~