CORE BTS

Flipping Locks (The Remix) - Remote Badge Cloning with the Flipper Zero and More

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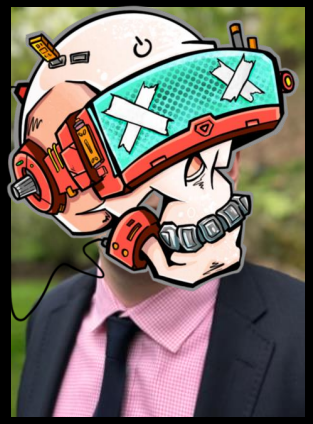
Meet Your Speakers

Langston “sh0ck” C., OSCP, OSWP, eCPPT

Principal Penetration Tester



Dan “jcache” G., OSCP

Senior Penetration Tester

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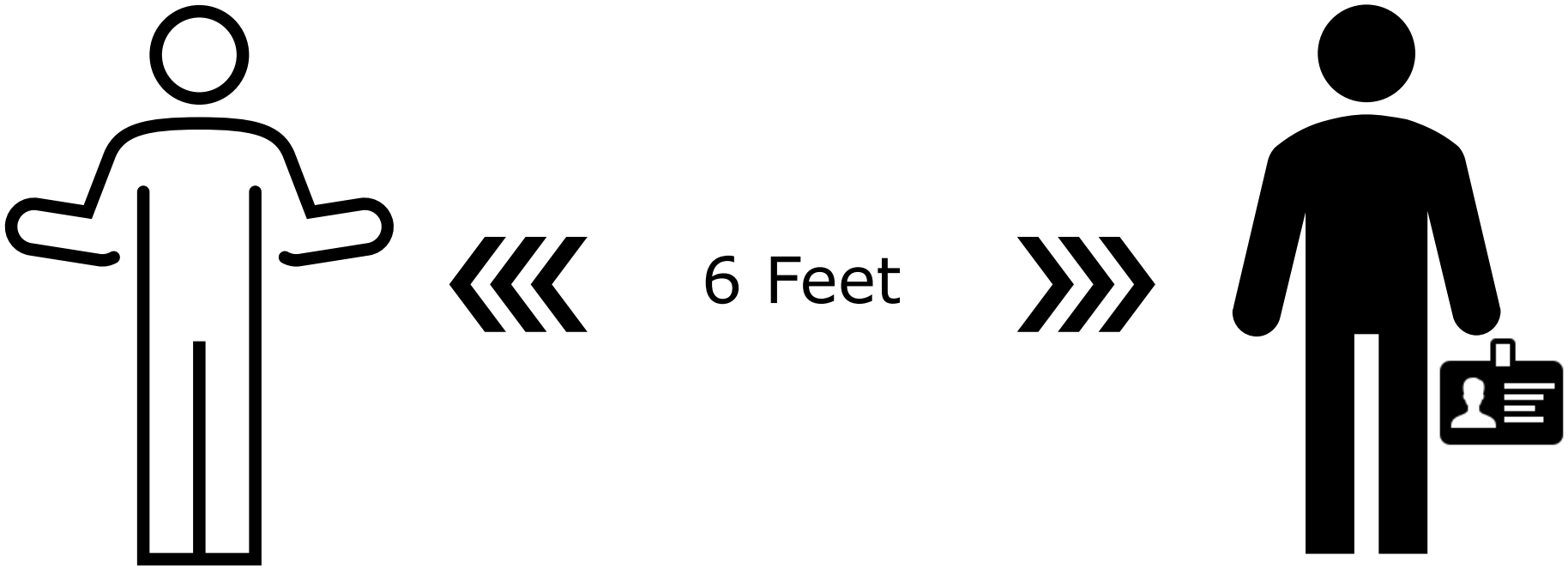
How Do You Conduct Physical Red Team Engagements During A Pandemic and Beyond?

The Initial Problem



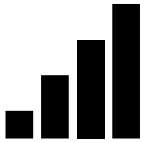
What is RFID Cloning?

- Radio Frequency Identification (RFID) technology supports many physical access control systems
- RFID access control technology provides convenient and cost-effective benefits
- These benefits come with many weaknesses
- Numerous implementations of RFID are susceptible to RFID cloning
- Threat actors can surreptitiously clone or copy RFID credentials under certain circumstances

Low Frequency VS High Frequency RFID

125 kHz

Less Secure



Long range

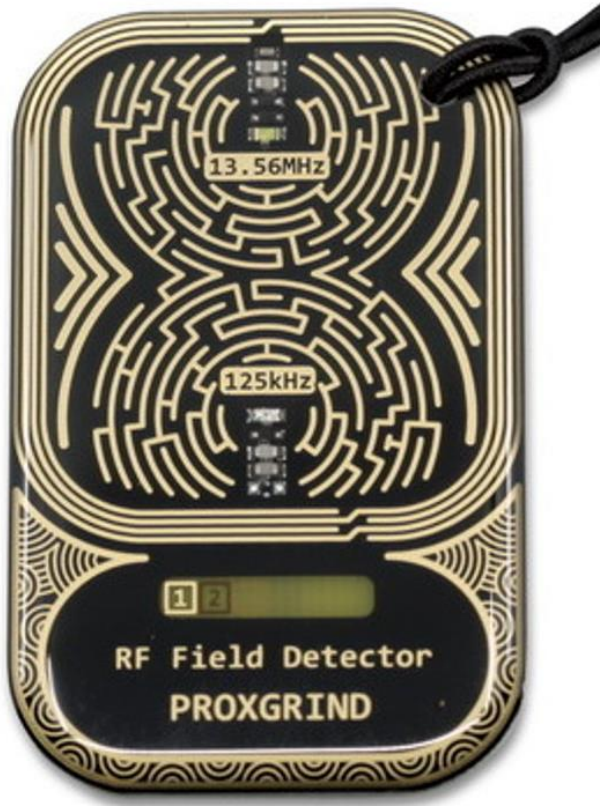
13.56 MHz

Secure

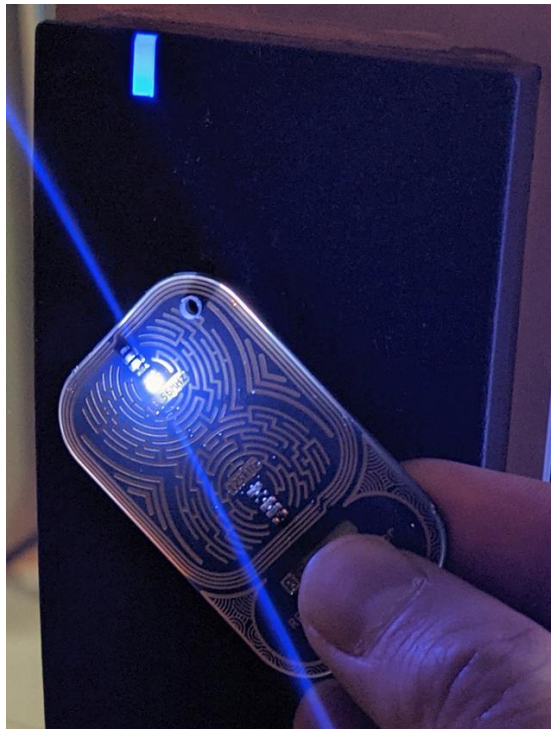
Short range

Reader Recon

- Proxgrind RF Field Detector



Red LED = 125Khz (Unencrypted)



White LED = 13.56Mhz (Encrypted)

Tutorial: https://www.youtube.com/watch?v=s7gusmY7kwY | Image Src: redteamtools.com

What if it does both?

- Proxgrind RF Field Detector

If it’s red, you’re dead. RIP Physical Security.

Traditional CQC (Close Quarter Cloning) Methods

Traditional CQC (Close Quarter Cloning) Methods

- **The Brush Pass RFID Method**
  ~ 2’-3’
  - Pros: Very stealthy and fast
  - Cons: Weak Signal Strength and not always socially distanced!

- **Clipboard Cloner Method**
  ~5"-7"
  - Pros: Portable and high signal strength
  - Cons: Less stealthy and not socially distanced!

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Badge Cloning without Boundaries
(6ft and Beyond!)

The Stand-Alone Wall Reader Implant

- Allows credential collection with little to no human interaction.
- Very stealthy, testers maintain anonymity.
- Remotely collect badge credentials through secured wireless.

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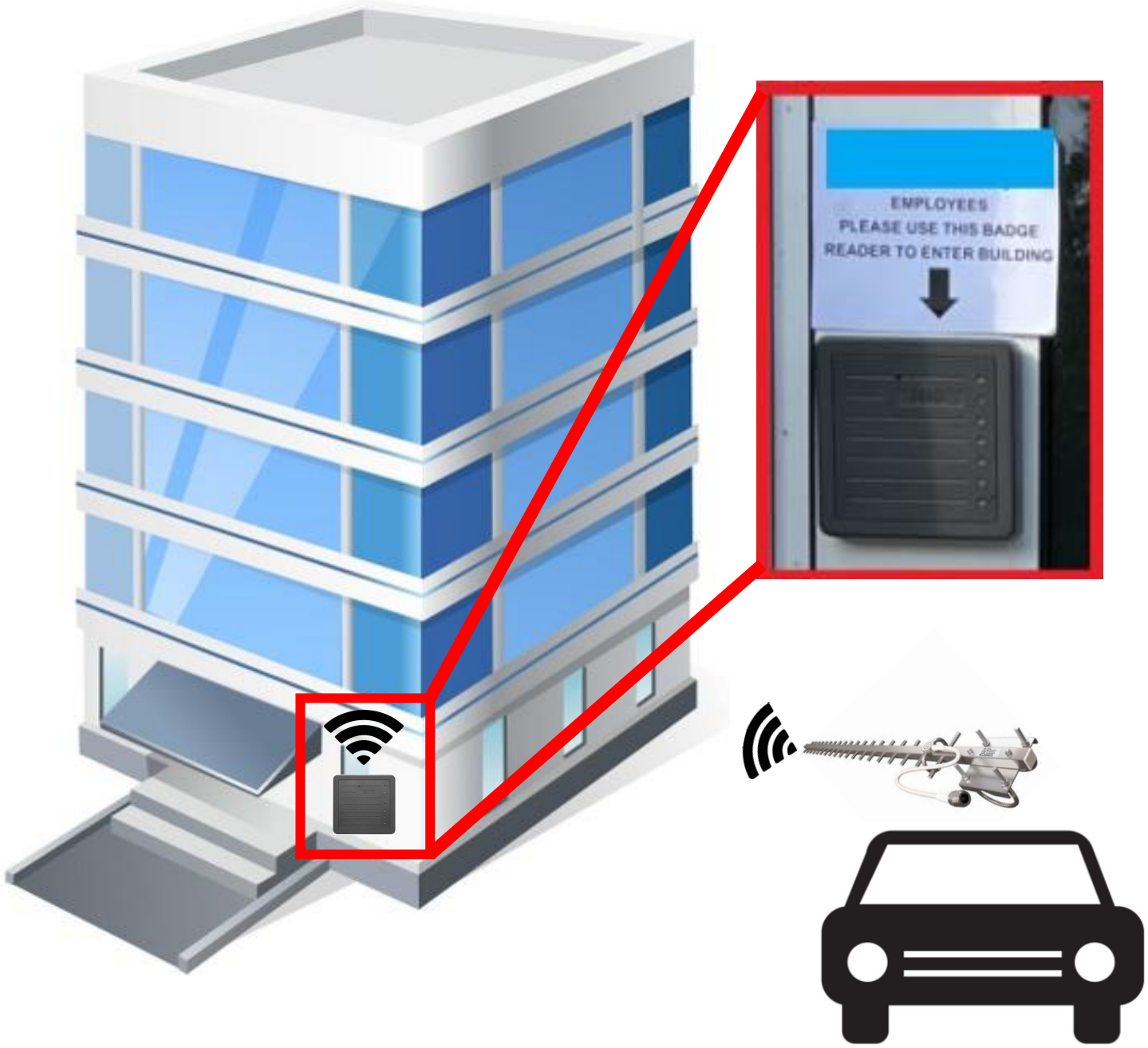
Grab the Loot!

Remotely Collect Card/FOB Key Loot from the ESP RFID Tool WiFi!

Grab your favorite long-range antenna and wait!



Rogue Reader Wireless Interface

- RFID ESP Key WiFi Access
  - SSID: "ESP-RFID-Tool"
    URL: http://192.168.1.1
- Default credentials to access the configuration page:
  - Username: "admin"
  - Password: "rfidtool"
- Change SSID to blend in with target organization
- Access Card Data in the "List Exfiltrated Data" Page

https://github.com/rfidtool/ESP-RFID-Tool

Rogue Reader Wireless Interface

Not secure 192.168.1.1/viewlog?payload=/Loot.txt

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List Exfiltrated Data

Download File - Delete File

Note: Preambles shown are only a guess based on card length and may not be accurate for every card format.

/Loot.txt
---
26 bit card,18 bit preamble,Binary:00000010000000001 10010000000001010011110011 HEX:2006400A73

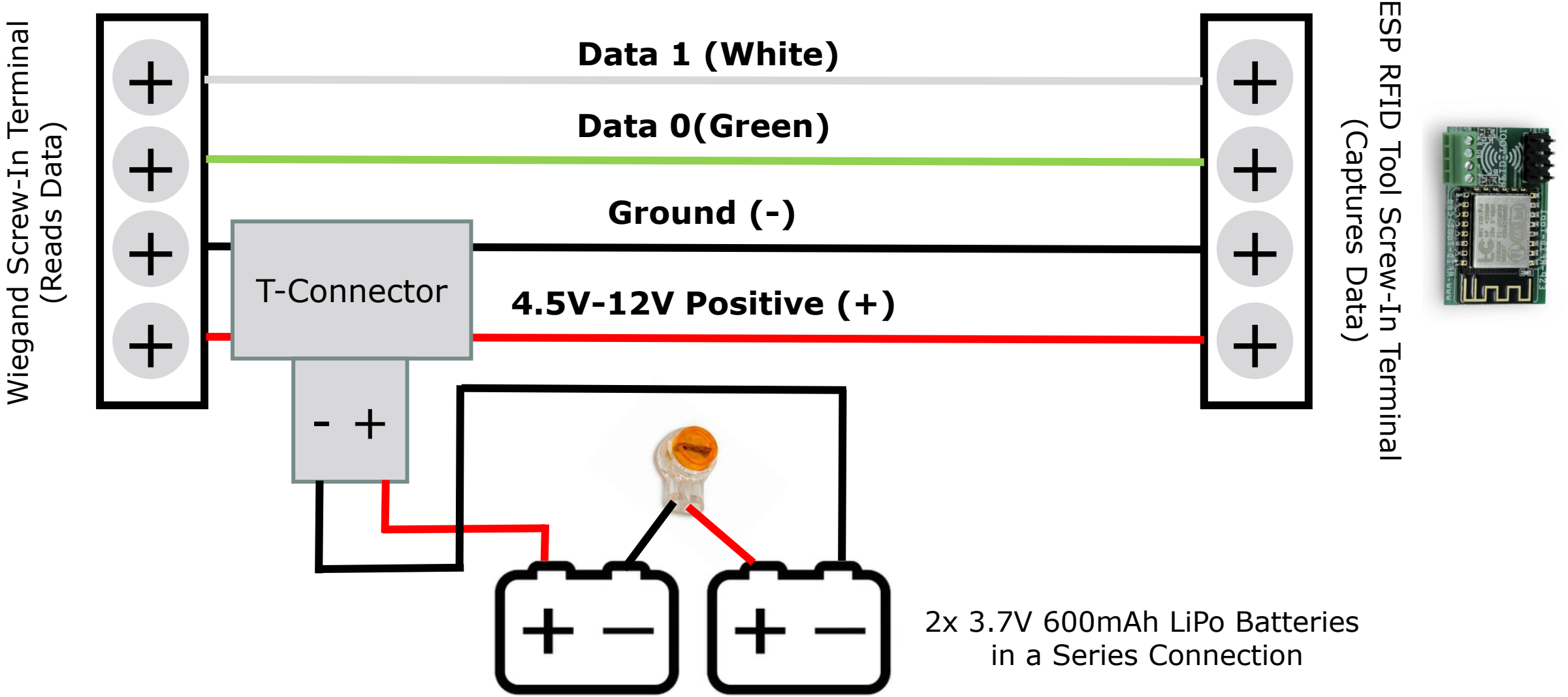
- Copy the Binary Code Payload for later!

Wall Reader Build – No Soldering Needed!

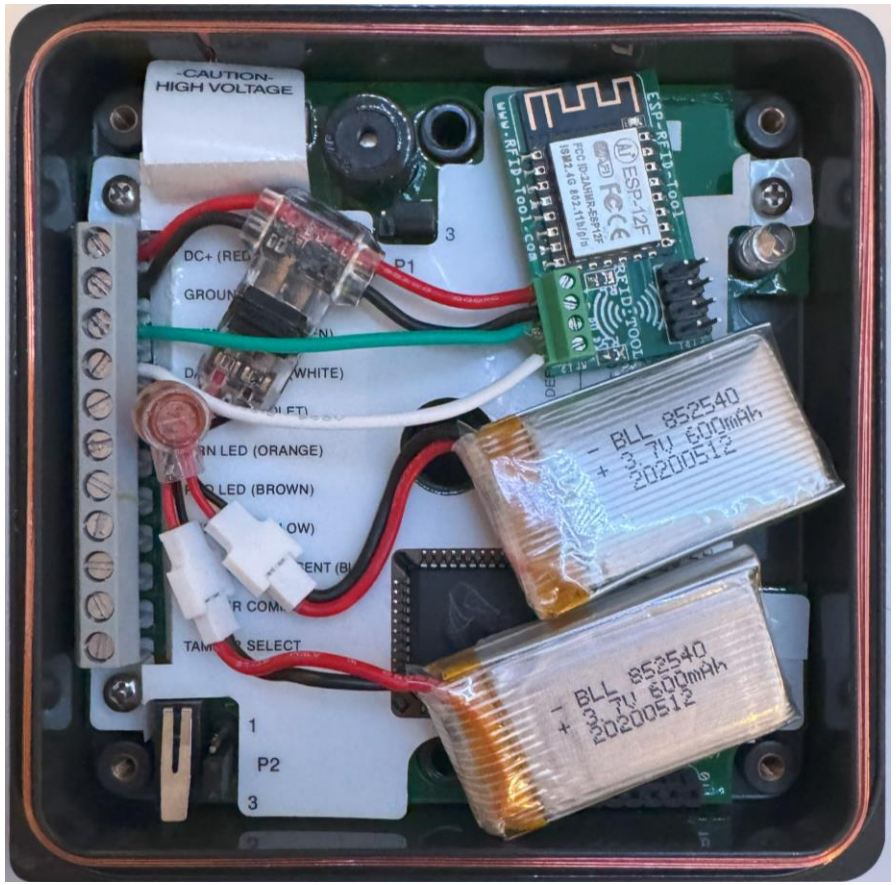
Low Frequency BOM (Build of Materials):

- HID Prox Pro 5355AGN00 Reader
- ESP RFID Tool OR ESPKey
- 3M Wall Hanging Strips
- 2x 3.7V 500mAh LiPo Batteries w/ JST connector
- 1x T Tap Connector
- 2x UY Wire to Wire Connector
- Bread Board Jumper Wires
- 22AWG electrical wire

Wall Reader Connection Guide



Compact Stand-Alone Wall Reader



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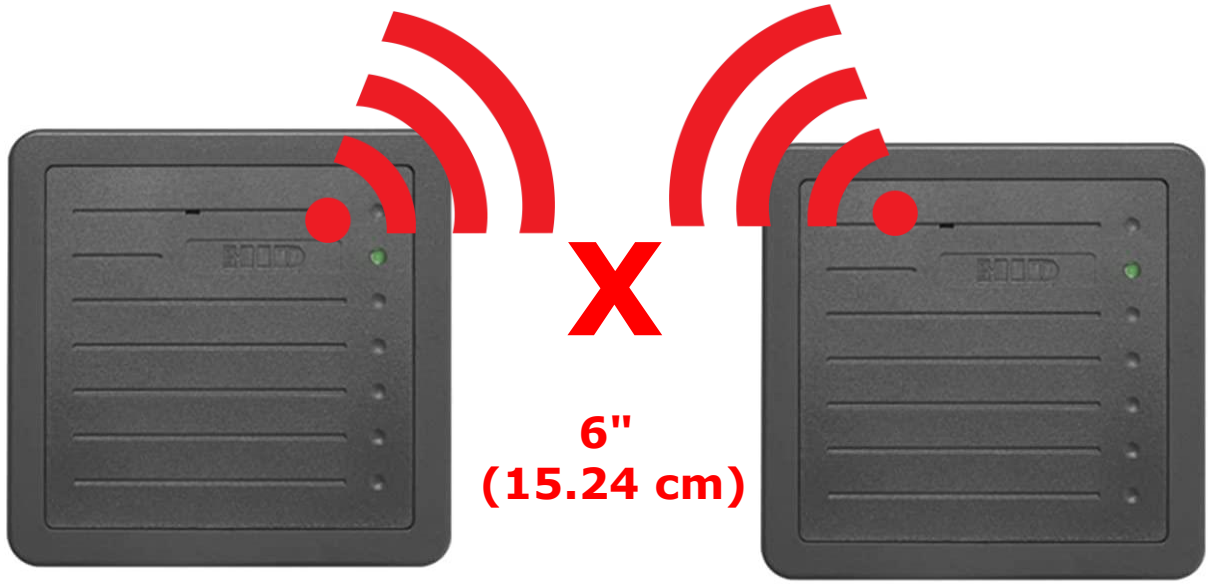
Misdirection with Low-Frequency

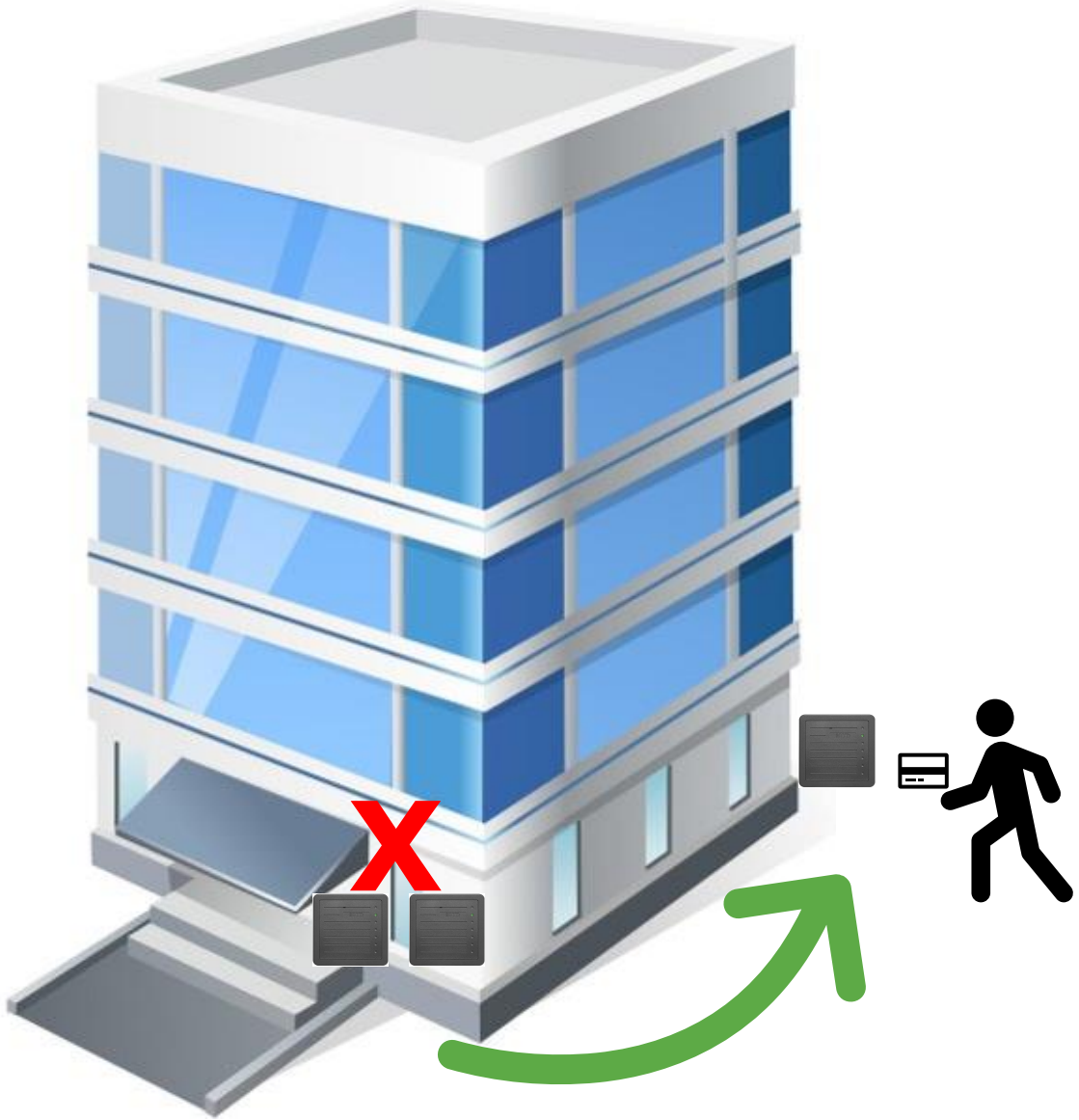
Misdirection – DOSing Readers

- Create a Social Engineering opportunity with a Badge Reader Denial of Service (DoS) attack!
- Placing two Low-Frequency RFID readers within 6" of each other causes interference and will jam the signal from reading card data.



Misdirection – DOSing Readers

- Create a Social Engineering opportunity with a Badge Reader DOS!
- Redirect employees to increase tailgating opportunities!



CQC - Clipboard Cloner!

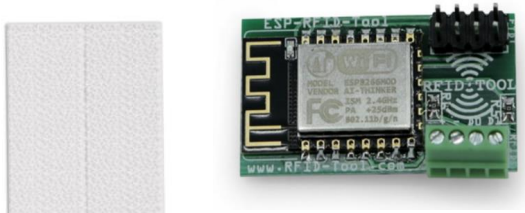
- Take the wall reader build and convert it into a stealthy Clipboard cloning device!

Full Clipboard Cloning build tutorial guide:
http://www.github.com/sh0ckSec/ClipboardCloner

Clipboard Cloner Build

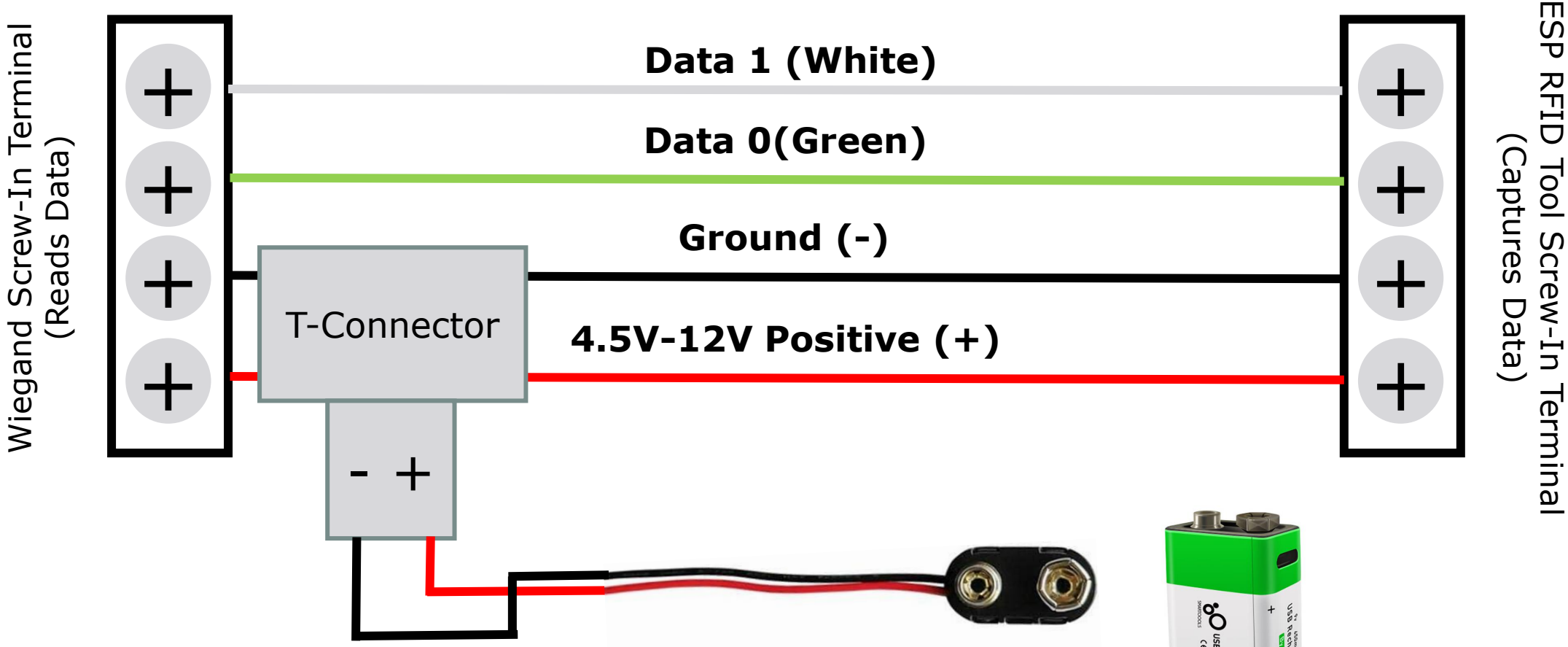
Low Frequency BOM (Build of Materials):

- HID Prox Pro 5355AGN00 Reader
- ESP RFID Tool OR ESPKey
- 3M Wall Hanging Strips
- 1x 9V 500mAh Rechargeable Battery
- 1x T Tap Connector
- Bread Board Jumper Wires
- 22AWG electrical wire
- Officemate Super Storage Supply Clipboard Case



Full Clipboard Cloning build tutorial guide:
http://www.github.com/sh0ckSec/ClipboardCloner

Clipboard Connection Guide – 9V Battery



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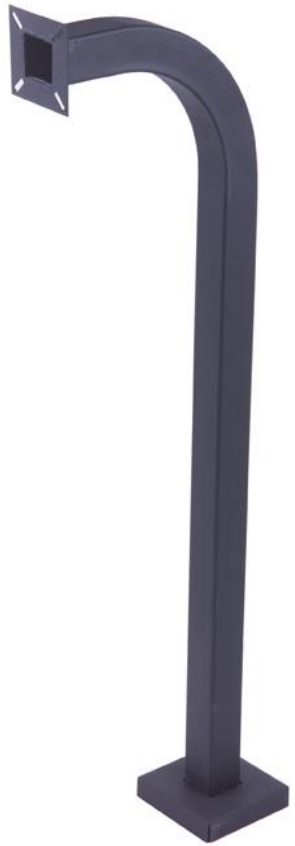
Introducing the Gooseneck Reader

The Gooseneck Reader

- **Simple, yet effective!**
  - Gooseneck Pedestal
  - Long Range Reader
  - Plywood
  - Rubber Feet
  - Spray Paint



The Gooseneck Reader

- Mobile Long-Range Reader for both Low or High Frequency
- Reads up to ~3.3' (1M) Away
- 12 Hour Battery

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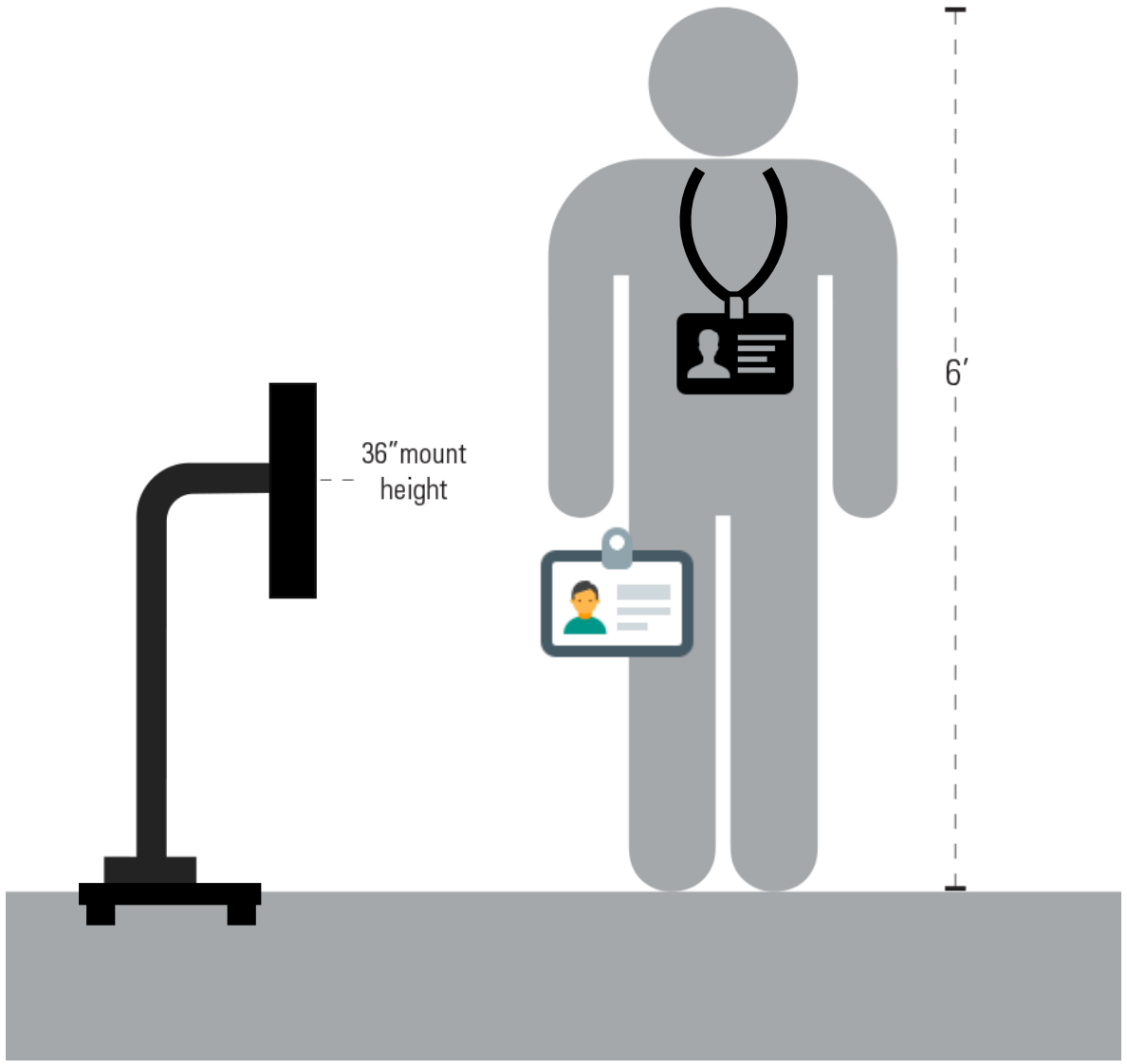


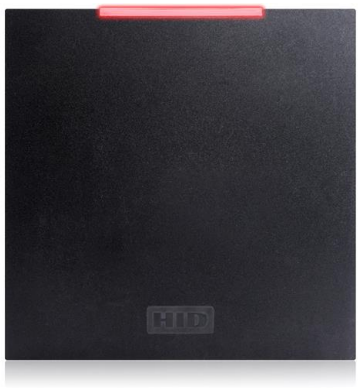
Gooseneck Build – No Soldering Needed!

Gooseneck BOM (Build of Materials):

- Low Frequency Long Range Reader
- (e.g. HID MaxiProx 5375)
- High Frequency Long Range Reader
- (e.g. HID iCLASS SE R90)
- MDF or Plywood Wood
- ESP RFID Tool
- 12V 6000mAh/5V 12000mAh DC Battery
- 3/8”x1.25” Nuts and Bolts
- Black Spray Paint
- Bread Board Jumper Wires
- 22AWG electrical wire
- DC Power Pigtail
- Rubber Feet
- Pedestal Pro Gooseneck

Full build tutorial guide:
www.github.com/sh0ckSec

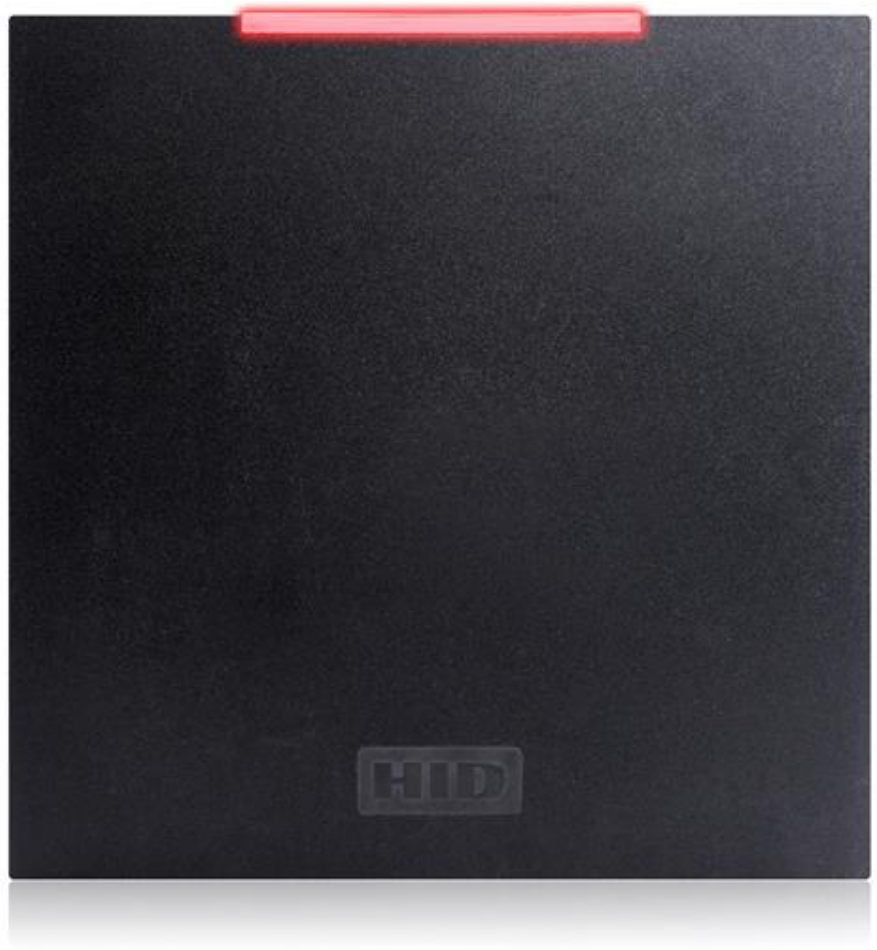


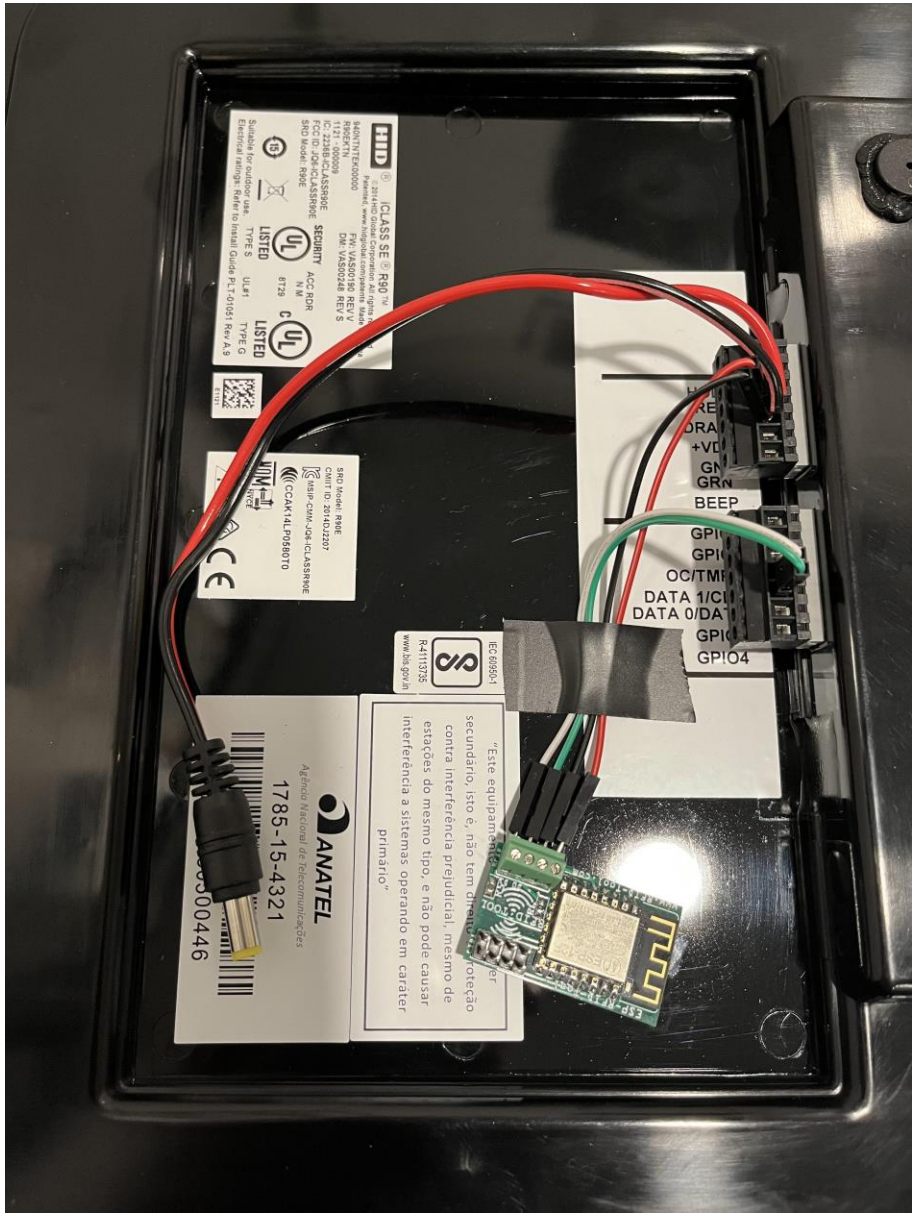




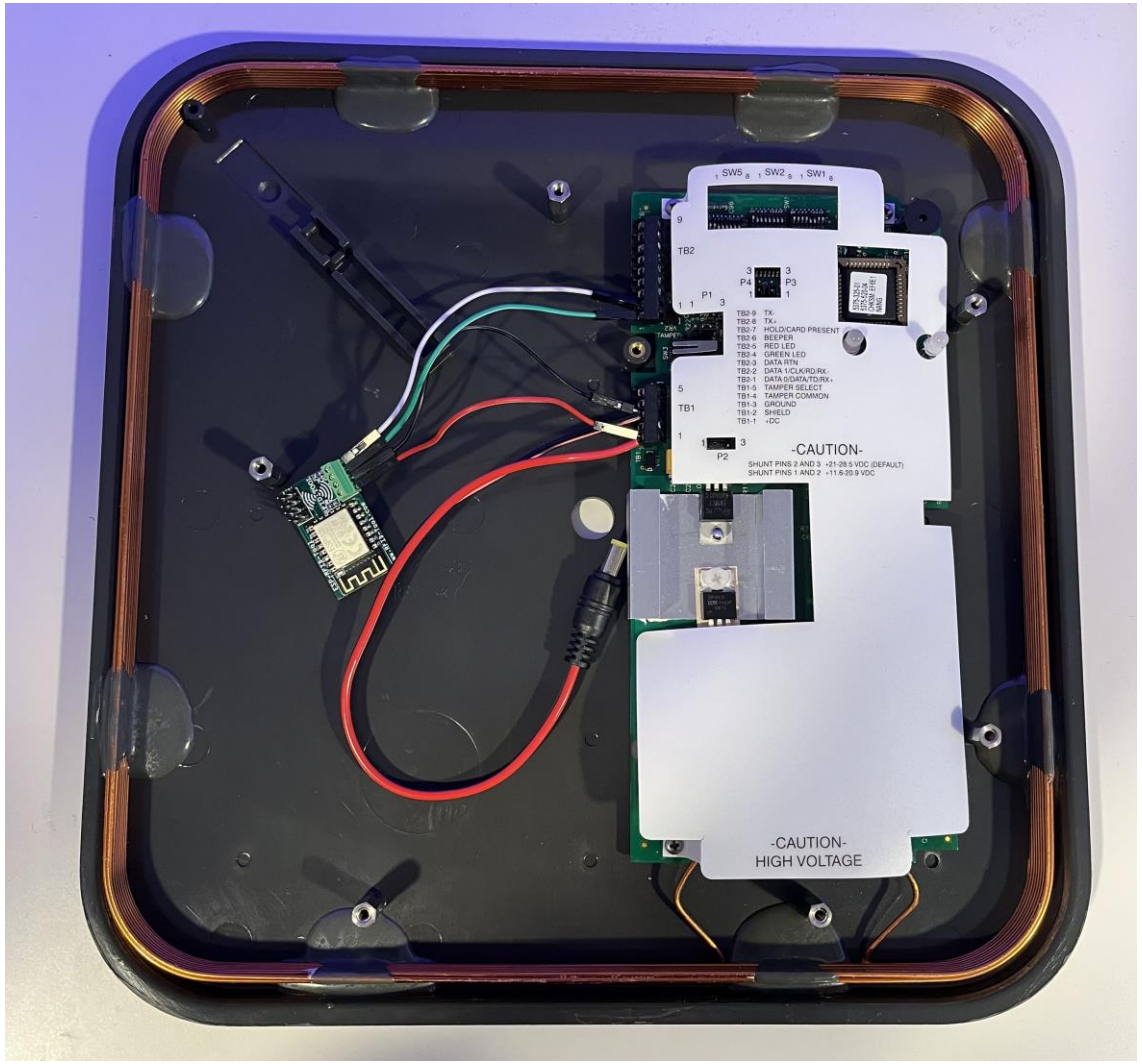

Long Range Reader Connection Guide

Long Range Reader Wiring





Long Range Reader Wiring

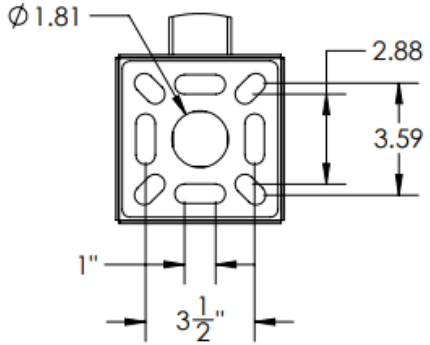


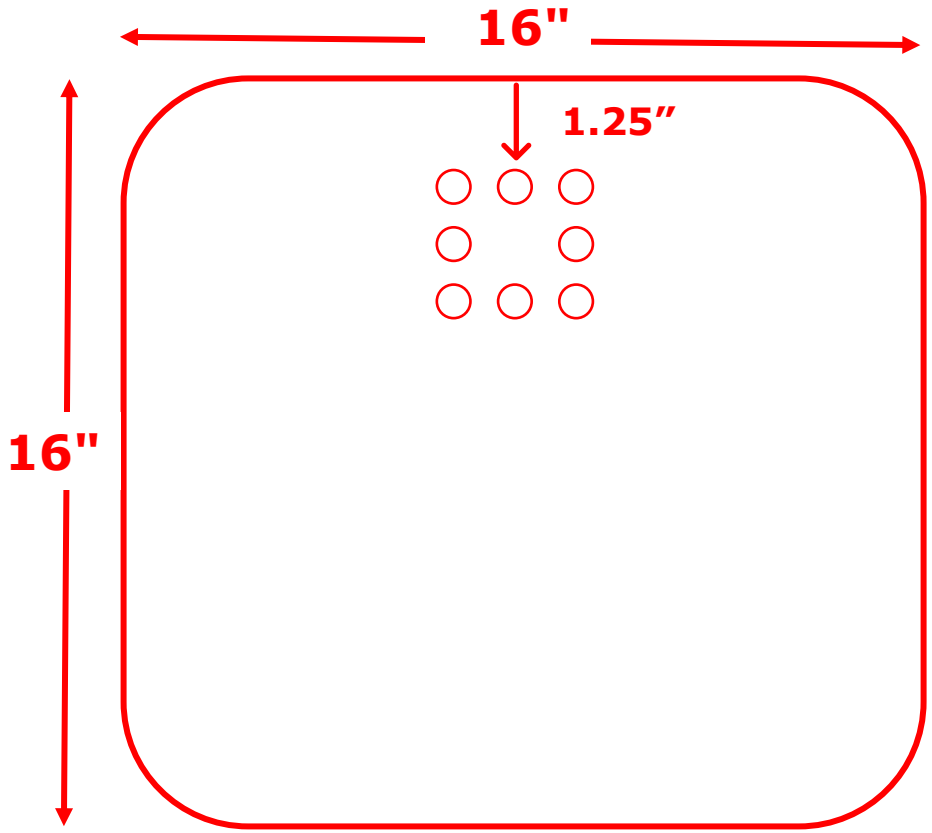
Gooseneck Base

Download the Gooseneck Base MK2 template here for laser cutting, CNC or print, along a full build tutorial guide:
www.github.com/sh0ckSec

Materials:

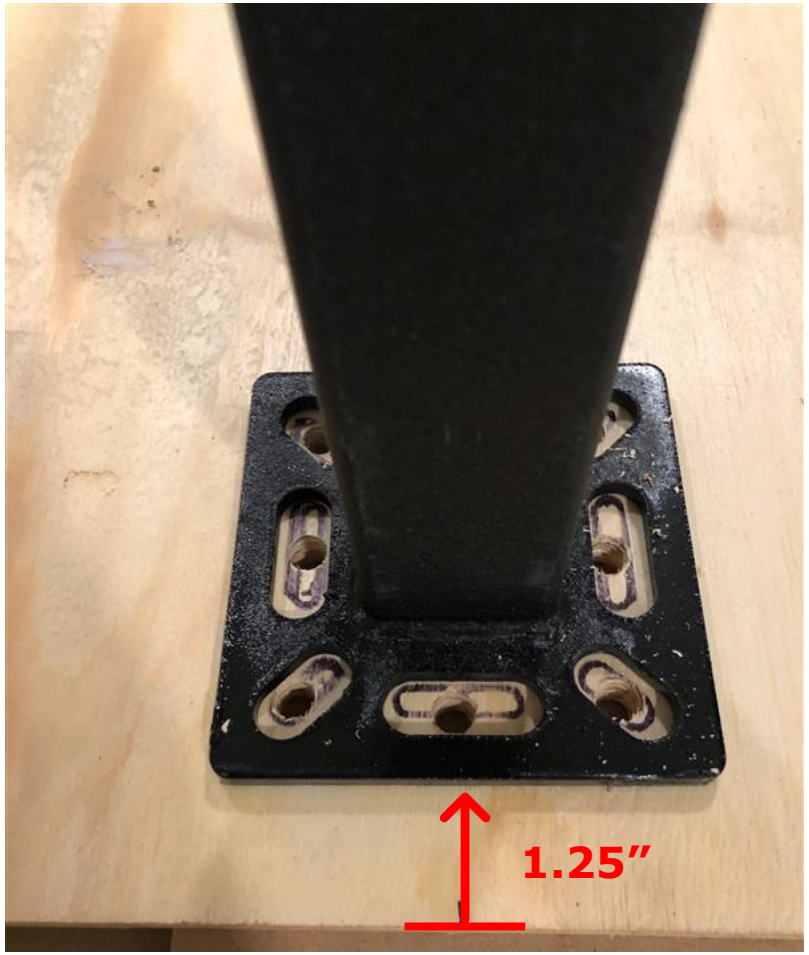
- 30mm Heavy Duty Rubber Furniture Pads
- 3/8” x 1 1/4" Carriage Bolts and Wing Nuts
- ½" thick MDF or Plywood



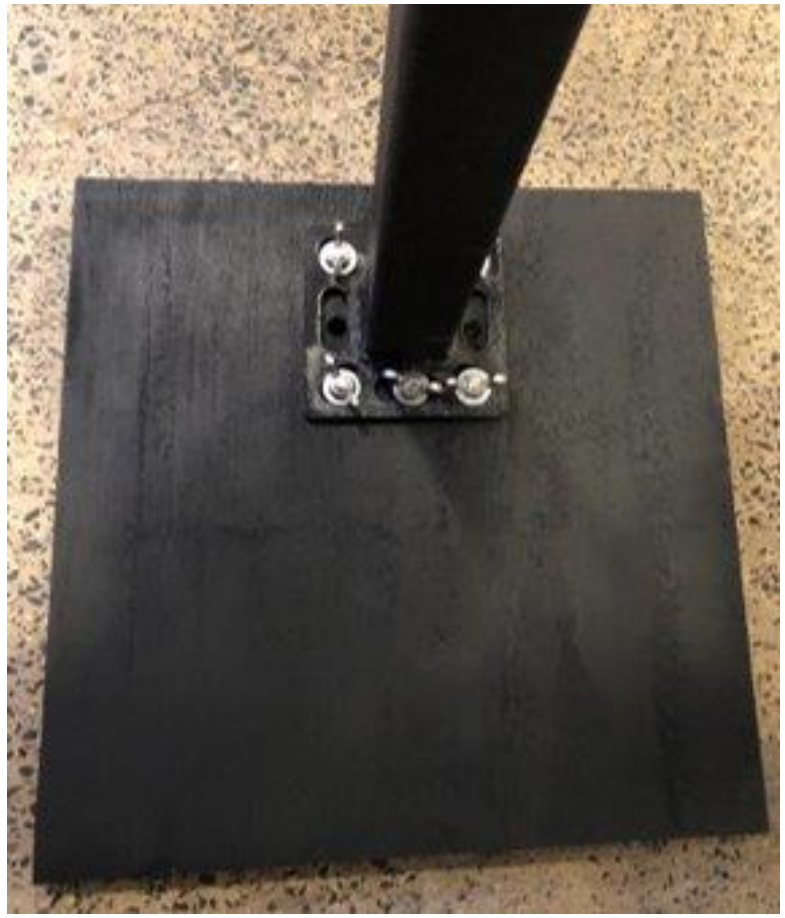


(40.62cm x 40.62cm)

Gooseneck Base – Installation



Gooseneck Base – Installation



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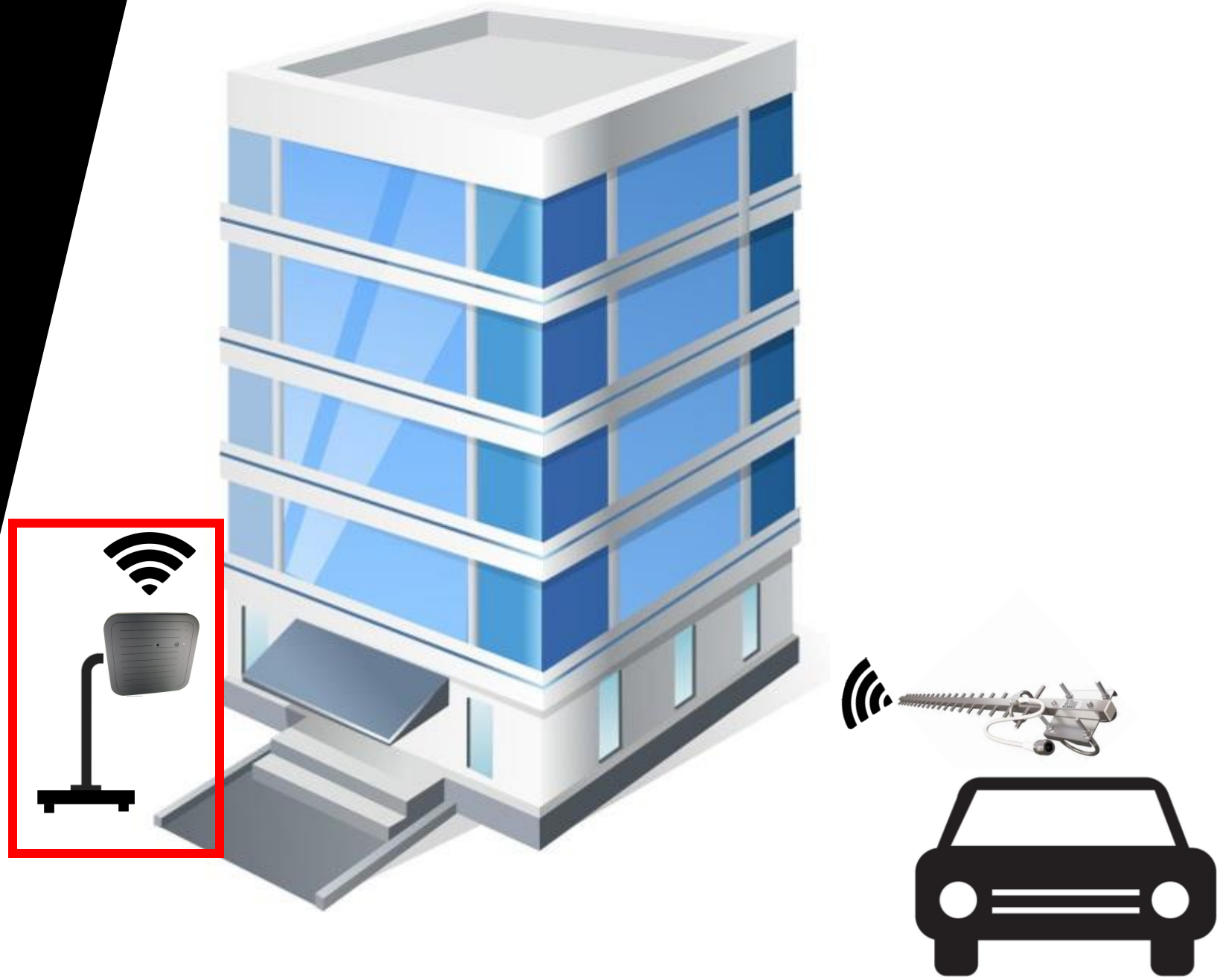
Grab the Loot!

Remotely Collect Card/FOB Key Data Loot from the ESP RFID Tool Wi-Fi!

Grab your favorite long-range antenna and wait!



Cloning Badge Data with a Flipper Zero

Quick, Cheap and Easy!

Flipper Zero RFID Copy Method

Materials Needed:

- Android Phone/Tablet or iPhone
- Flipper Zero
- Blank T5577 Rewriteable RFID Cards
- Bin-HEX Converter App
- **Flipper Mobile App**
  https://flipperzero.one/

Rogue Reader Wireless Interface (125Khz)

Not secure 192.168.1.1/viewlog?payload=/Loot.txt

<- BACK TO INDEX

List Exfiltrated Data

Download File - Delete File

Note: Preambles shown are only a guess based on card length and may not be accurate for every card format.

```
/Loot.txt
-----
26 bit card,18 bit preamble,Binary:00000100000000001 10010000000001010011110011 HEX:2006400A73
```

Binary Conversion to HEX for Flipper Zero

```
/Loot.txt
-----
26 bit card,18 bit preamble,Binary:000000100000000001 100100000000001010011110011,HEX:2006400A73
```

1. Copy the second half of the binary data:

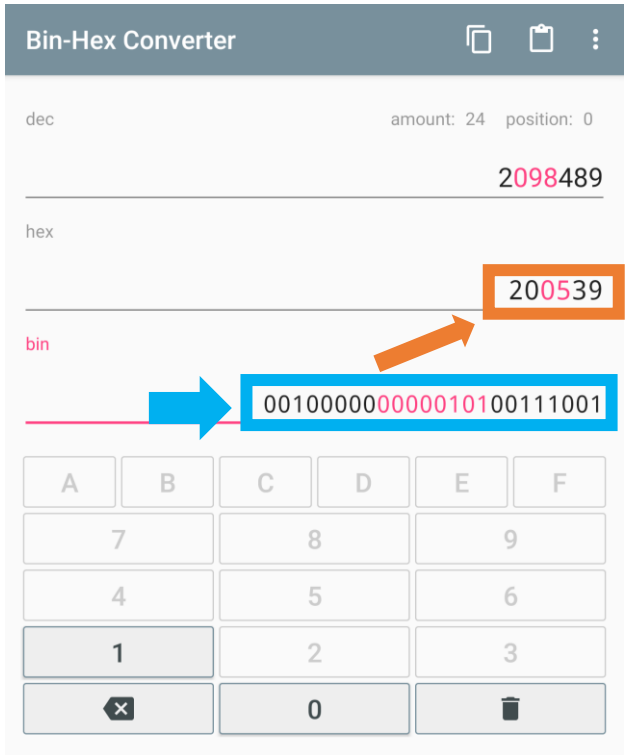
   100100000000010100111 0011

2. REMOVE the leading and trailing parity bits:

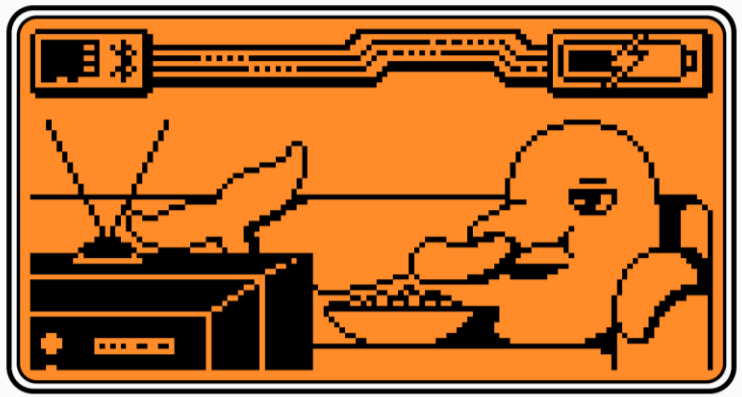
   ~~1~~ **0010000000001010011100 1** ~~1~~

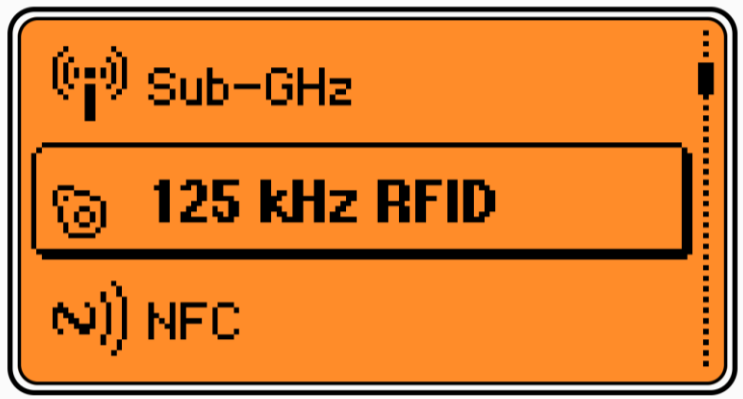
3. Take this and convert into HEX using a Bin-HEX Converter

   0010000000001010011100 1 = **20 05 39**

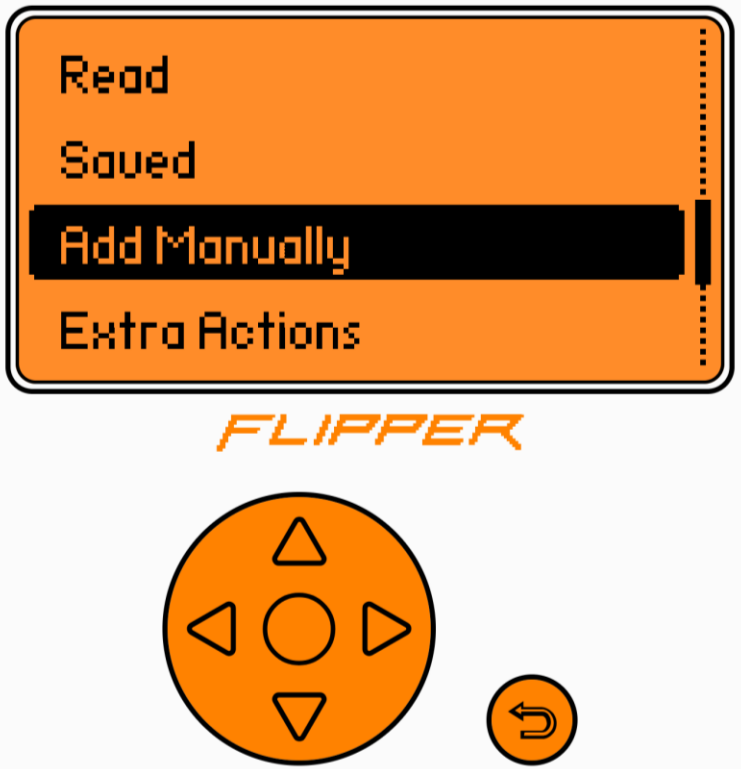


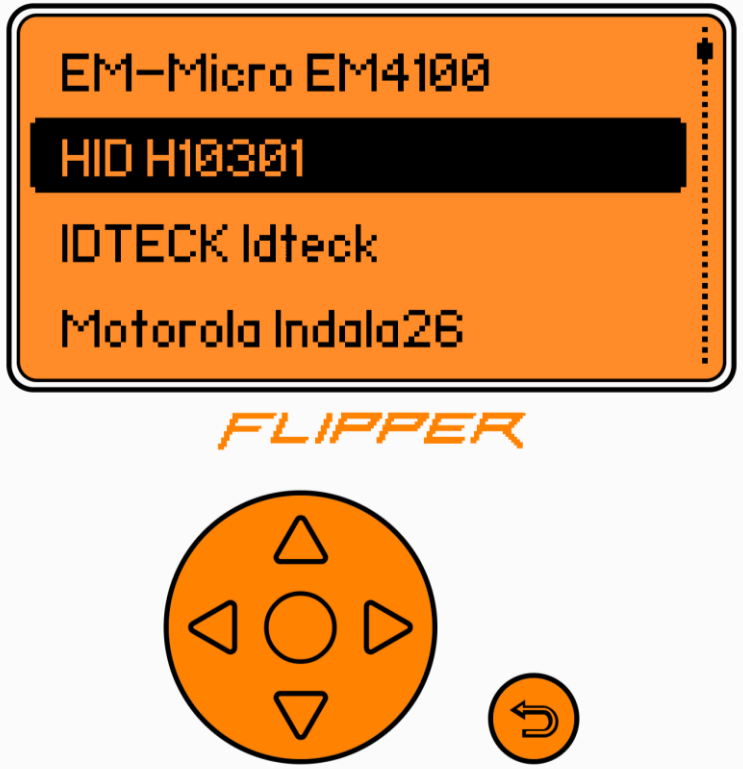
Flipper Zero – Adding Card

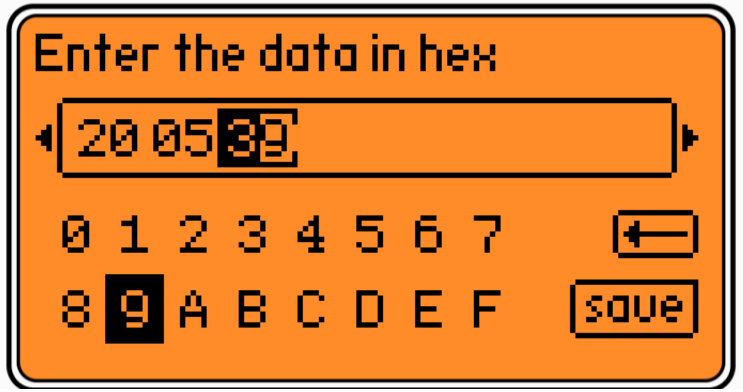


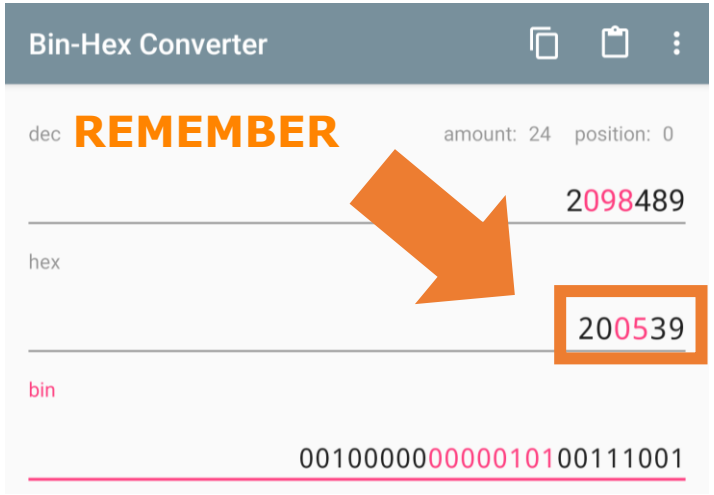


Flipper Zero – Adding Card

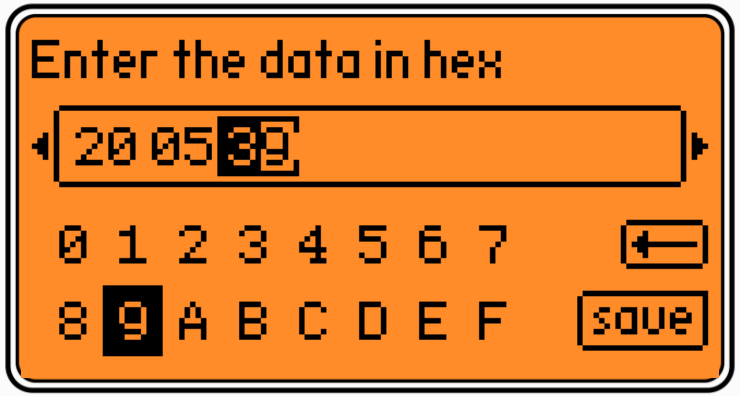


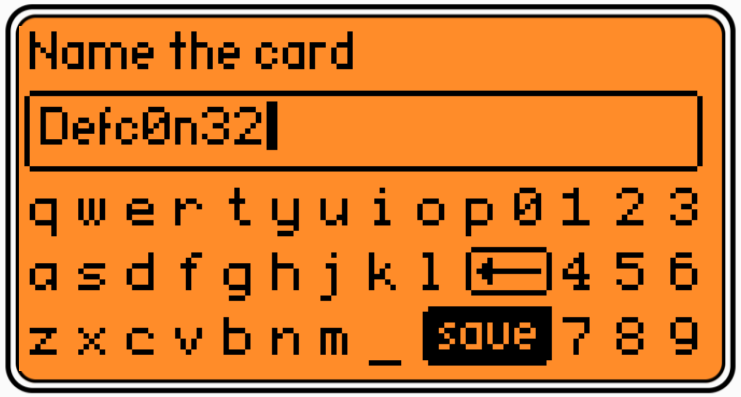


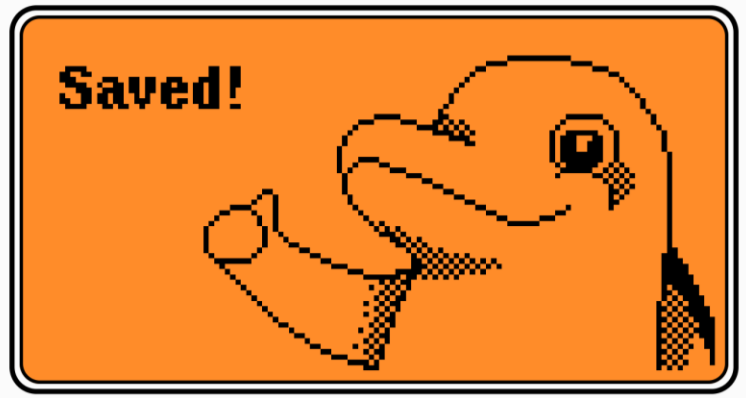




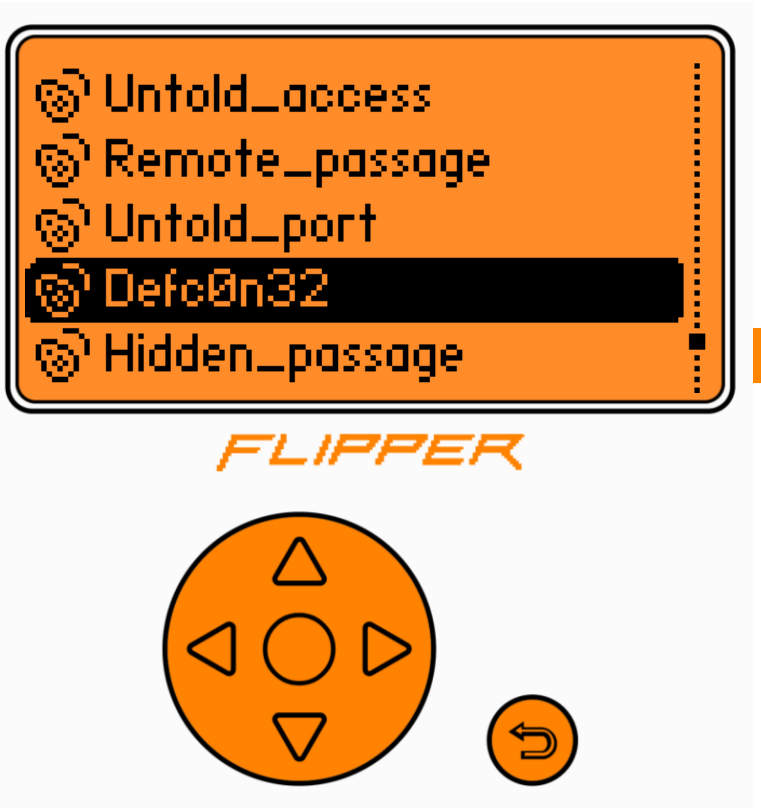
Flipper Zero – Saving Card

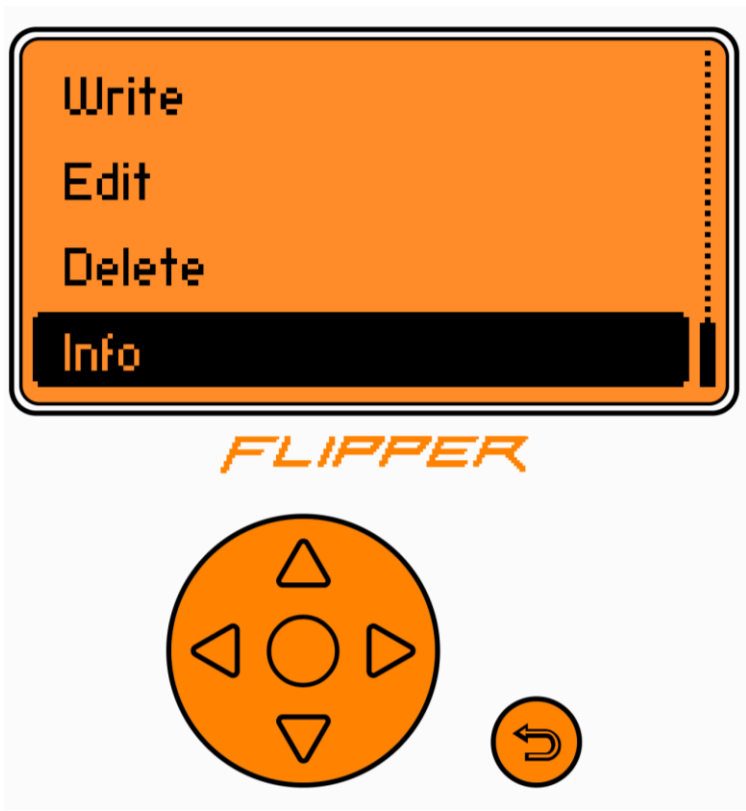


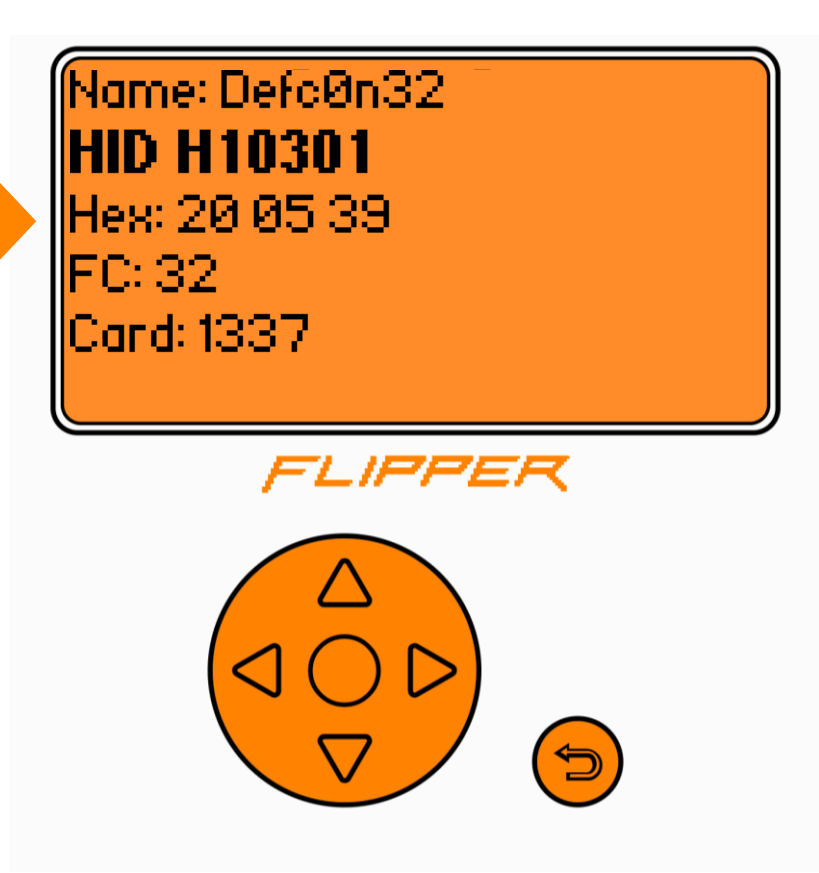




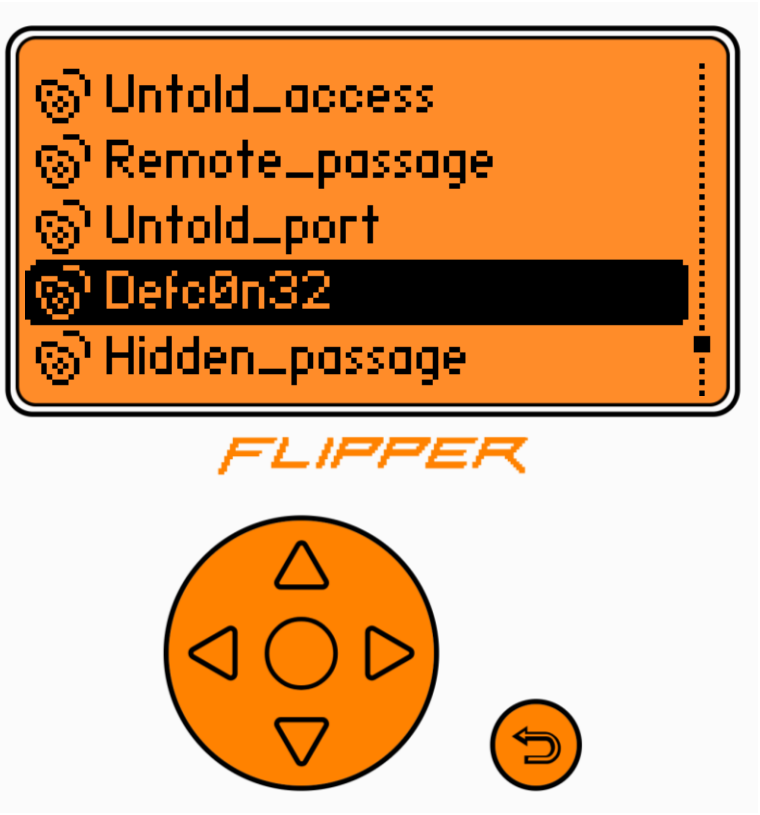
Flipper Zero – Reading Card Info

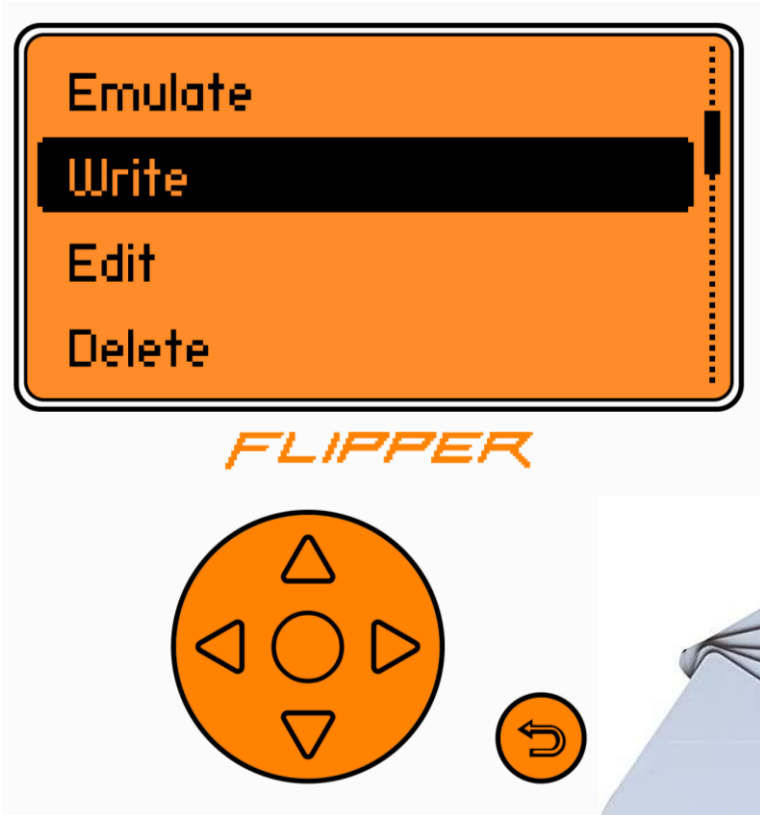


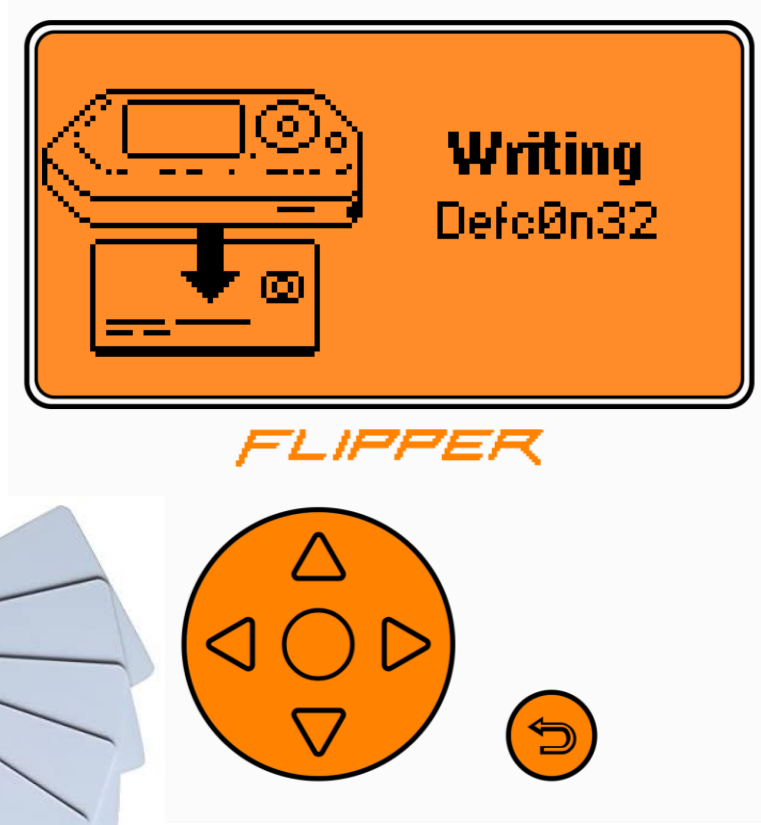




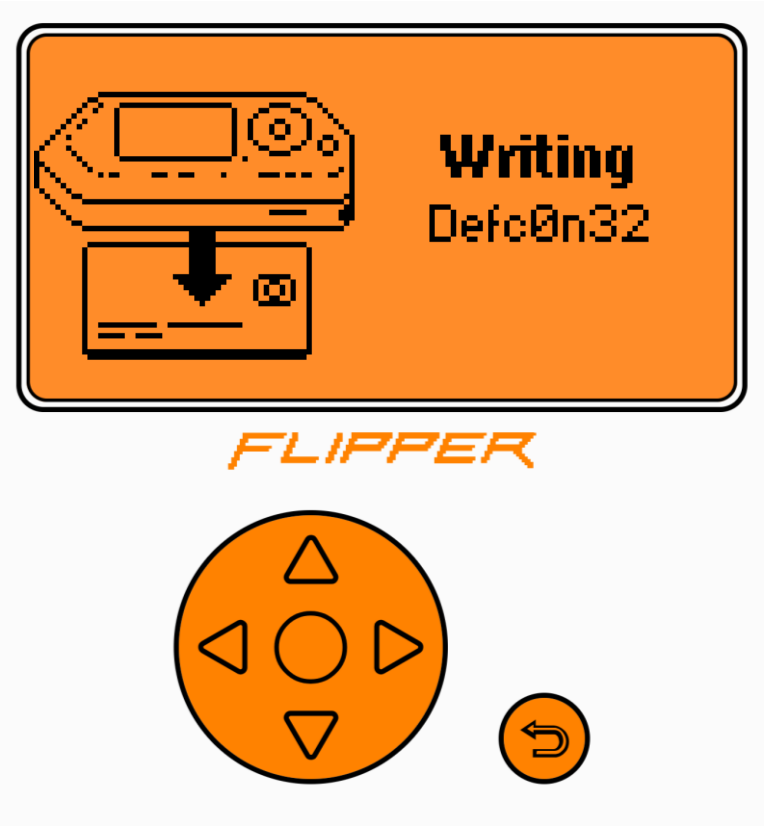
Flipper Zero – Writing Card To Blank Badge

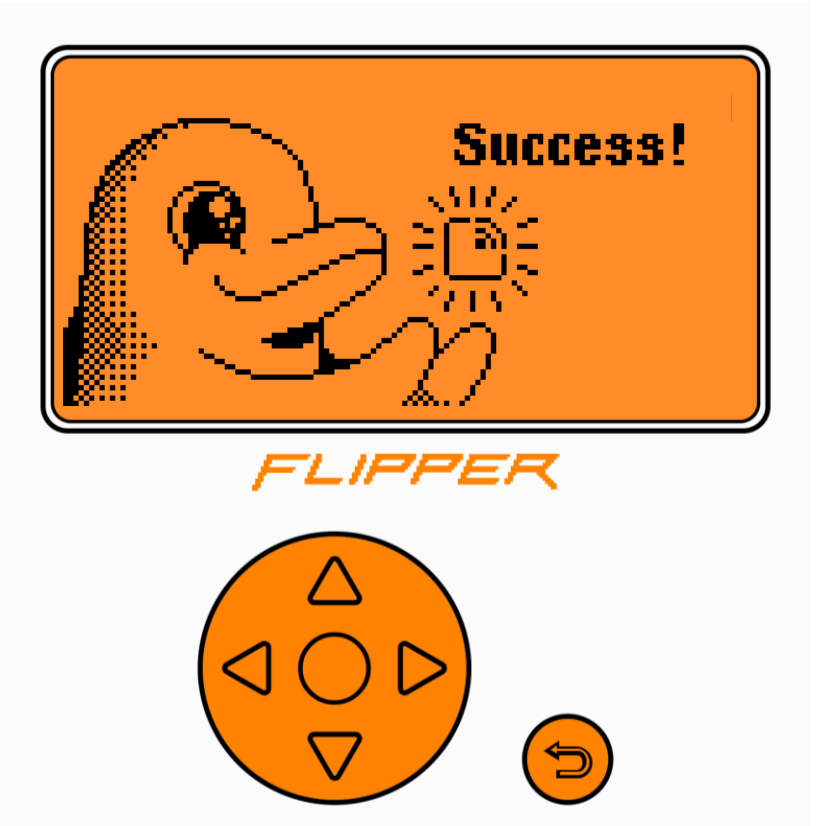






Flipper Zero – Writing Card To Blank Badge





HID SE/SEOS Cloning

Stealthy Attacks!

HID Reader Protocols

Traditional HID

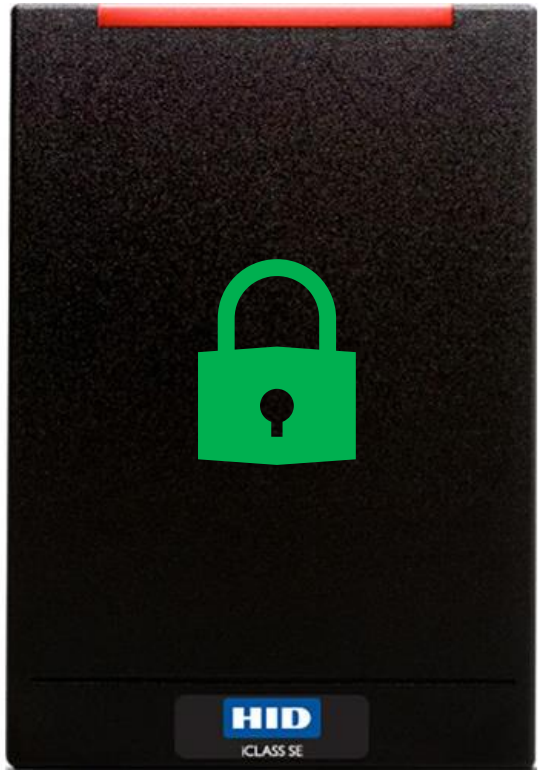
125Khz (Unencrypted)
~~13.56hz (Encrypted)~~

VS.

HID multiCLASS SE

125Khz (Unencrypted)
13.56hz (Encrypted)

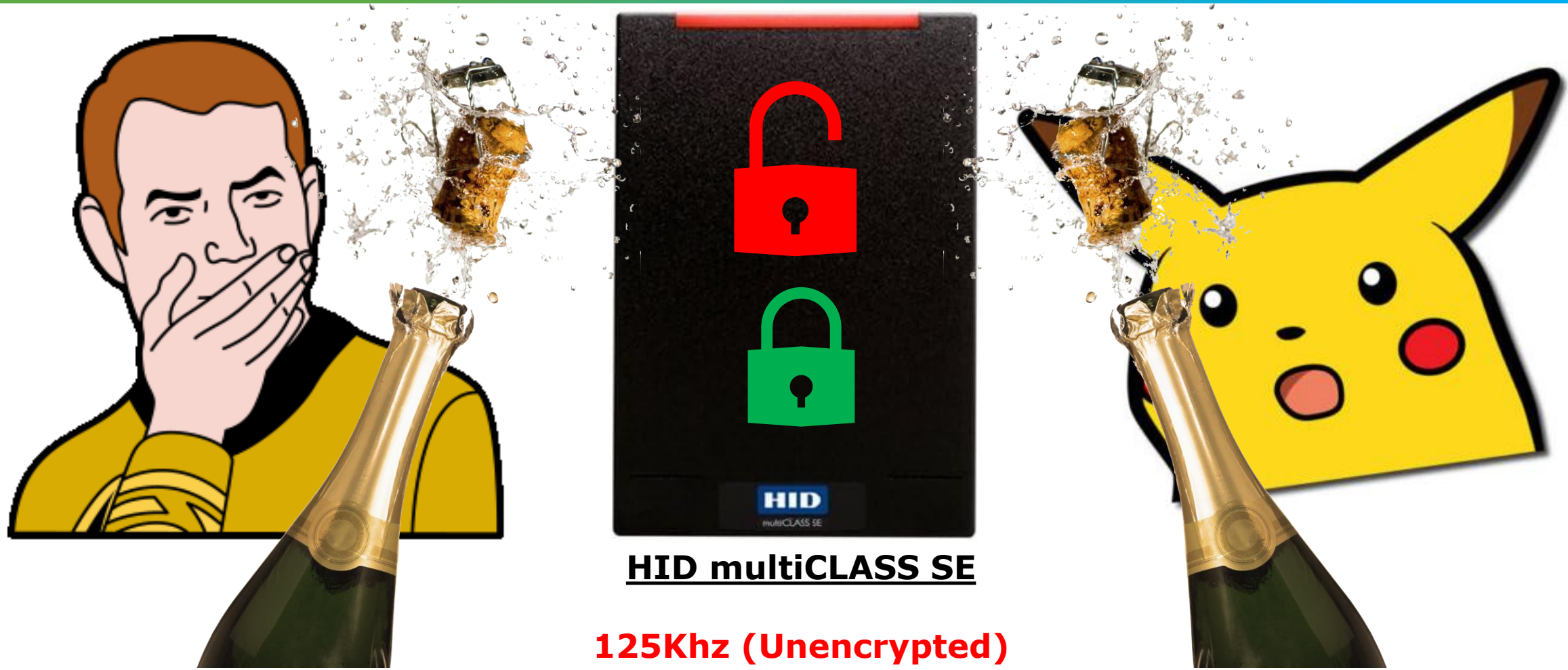
VS.



HID iCLASS SE

~~125Khz (Unencrypted)~~
13.56hz (Encrypted)

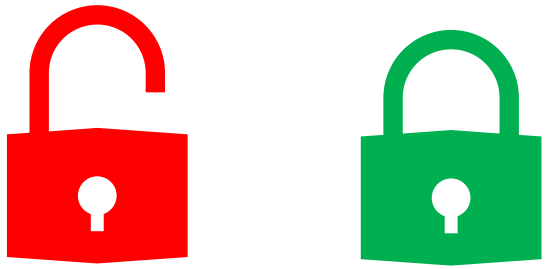
HID multiCLASS SE = Party Time.



HID multiCLASS SE

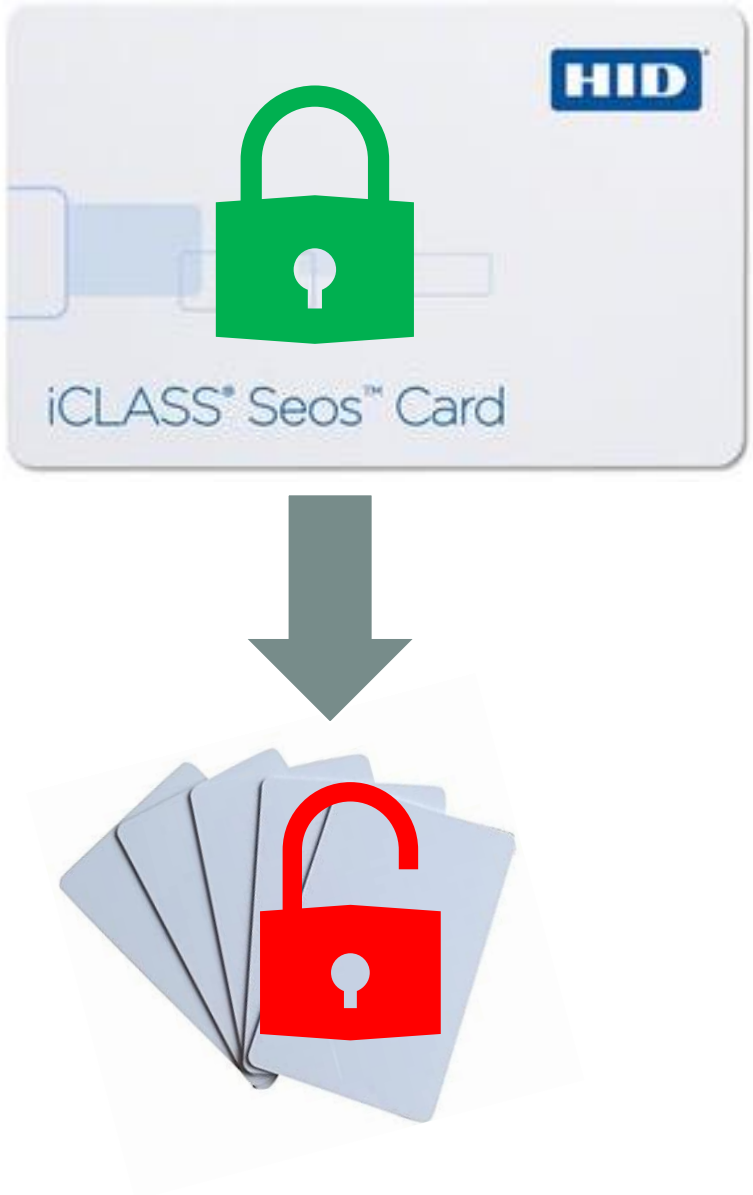
125Khz (Unencrypted)
13.56hz (Encrypted)

HID multiCLASS SE = Party Time.



#1
HID SE/SEOS Downgrade Attack

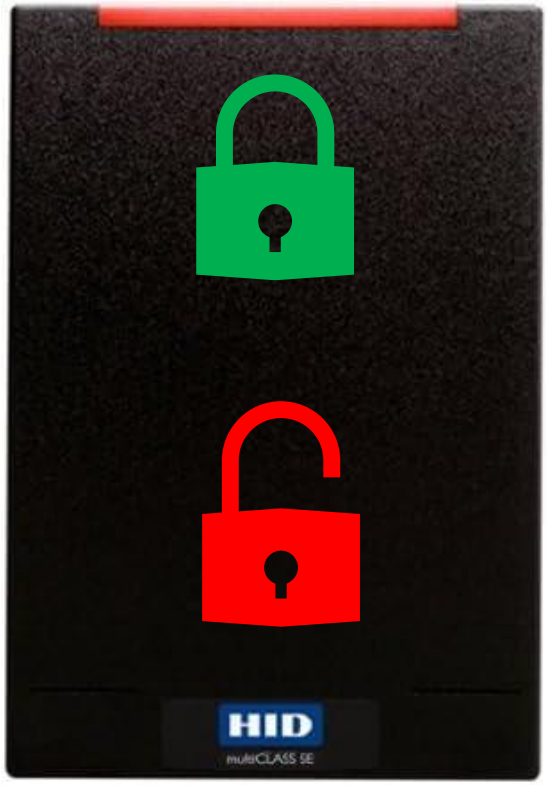
From Encrypted to Unencrypted!



HID SE/SEOS Downgrade Attack

FC = 208 | Card No. = 16398

FC = 208 | Card No. = 16398



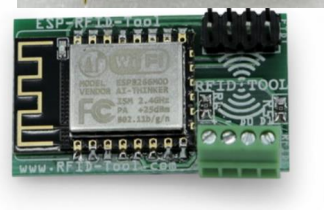
HID multiCLASS SE

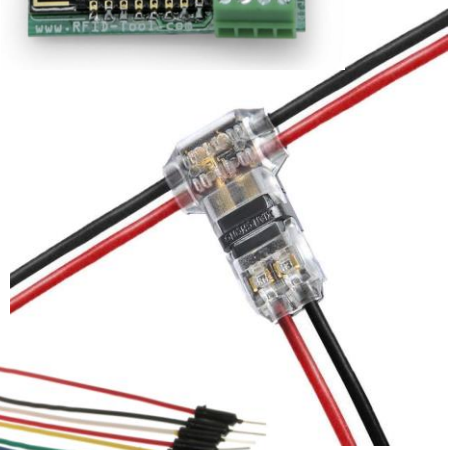
Downgrade Attack Build

Downgrade Attack BOM (Build of Materials):

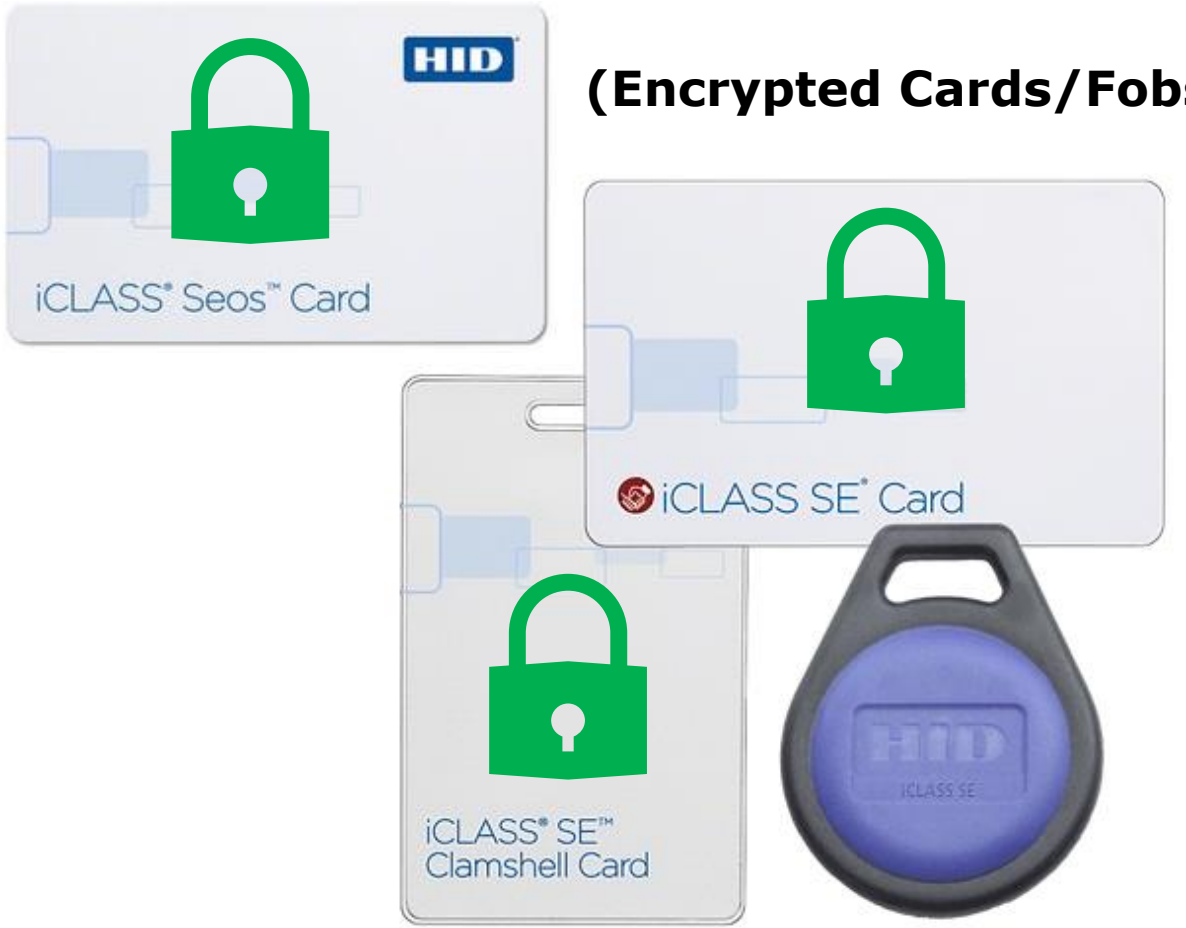
- **HID RP40** (multiclass SE) or **R40** (iCLASS SE)
- ESP RFID Tool OR ESPKey
- 3M Wall Hanging Strips
- 1x 9V 500mAh Rechargeable Battery
- 1x T Tap Connector
- Bread Board Jumper Wires
- 22AWG electrical wire
- Officemate Super Storage Supply Clipboard Case

Full Clipboard Cloning build tutorial guide:
http://www.github.com/sh0ckSec/ClipboardCloner



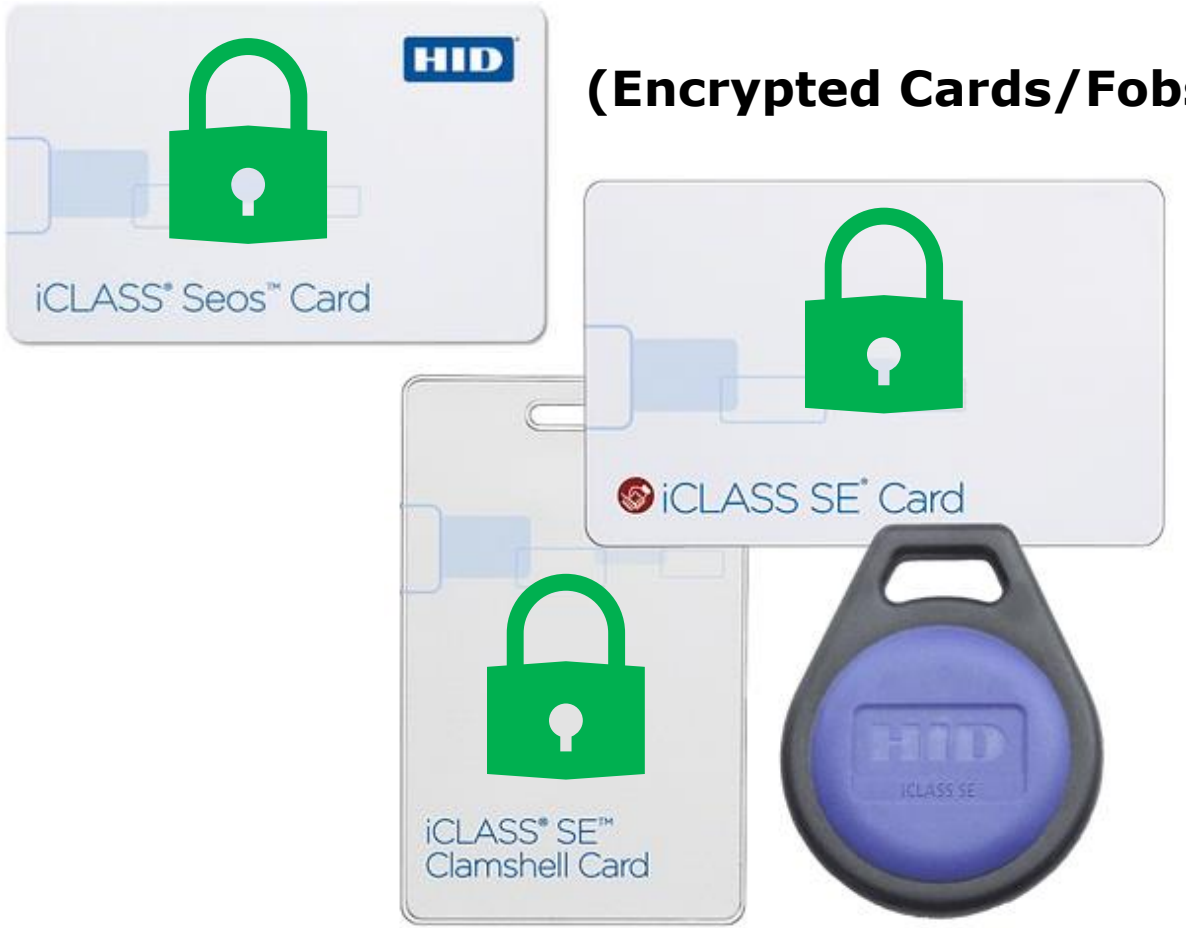


HID SE/SEOS Downgrade Attack – Part 1



(Encrypted Cards/Fobs)

HID SE/SEOS Downgrade Attack – Part 1



(Encrypted Cards/Fobs)

HID SE/SEOS Downgrade Attack – Part 2

```
/Loot.txt
-----
26 bit card,18 bit preamble,Binary:00000010000000001 01100101101000000000011100 HEX:200596801C
```

1. Copy the second half of the binary data:

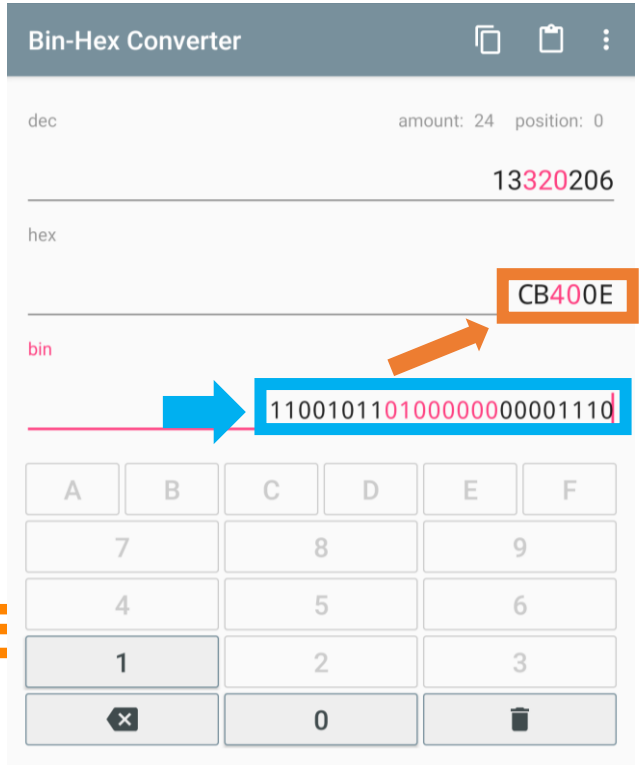
   01100101101000000000011100

2. REMOVE the leading and trailing parity bits:

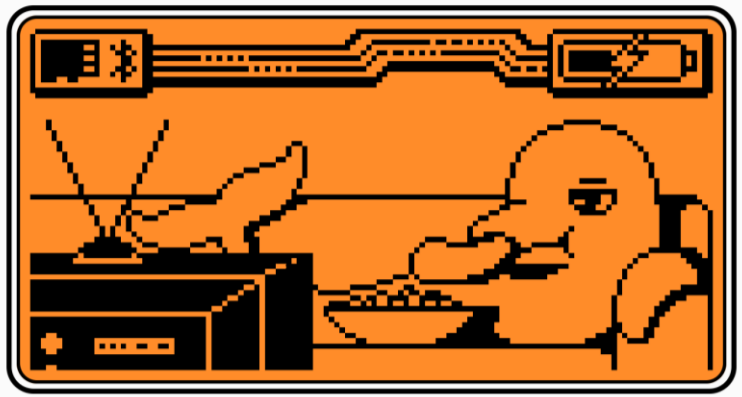
   ~~0~~ **110010110100000000001110** ~~0~~

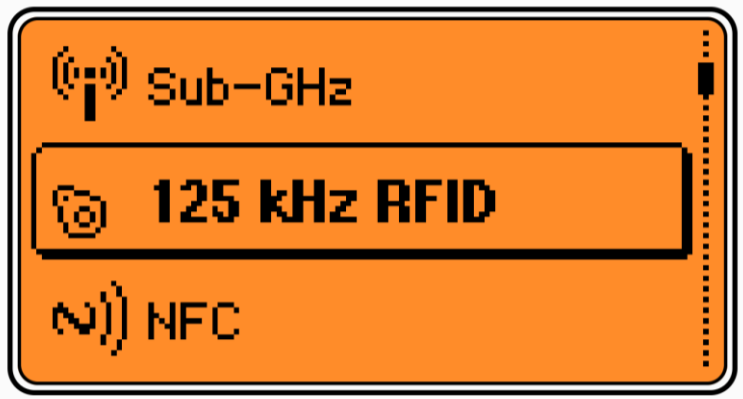
3. Take this and convert into HEX using a Bin-HEX Converter

110010110100000000001110 = CB 40 0E

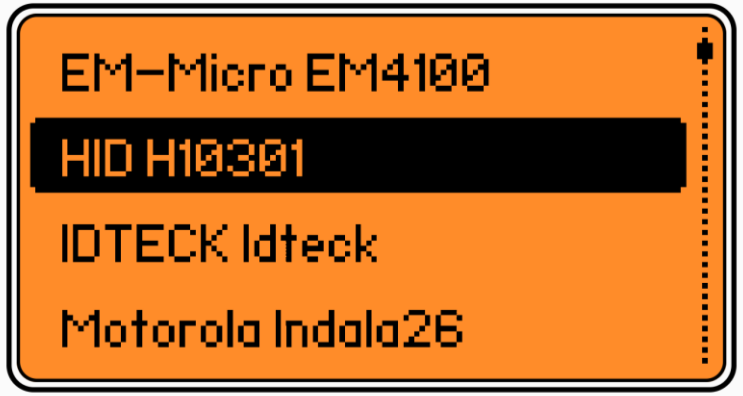


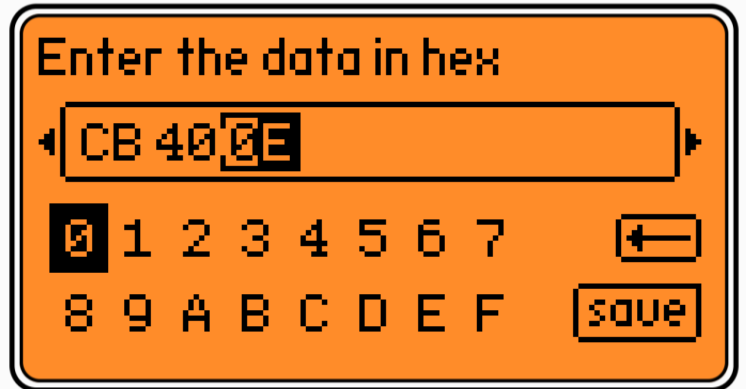
Flipper Zero – Downgrade Attack

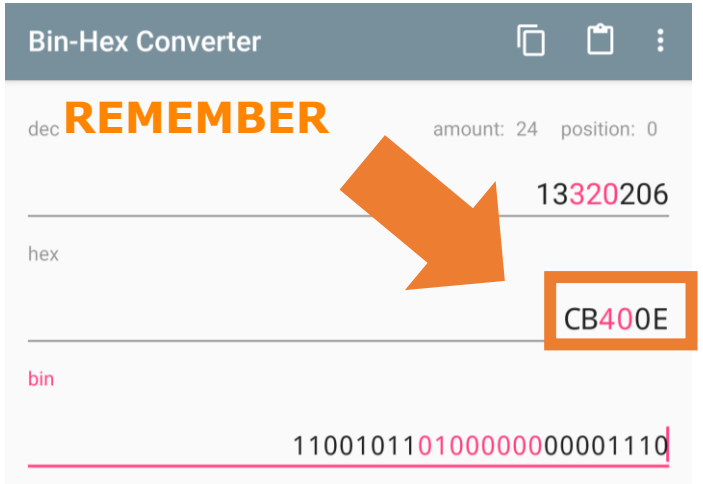




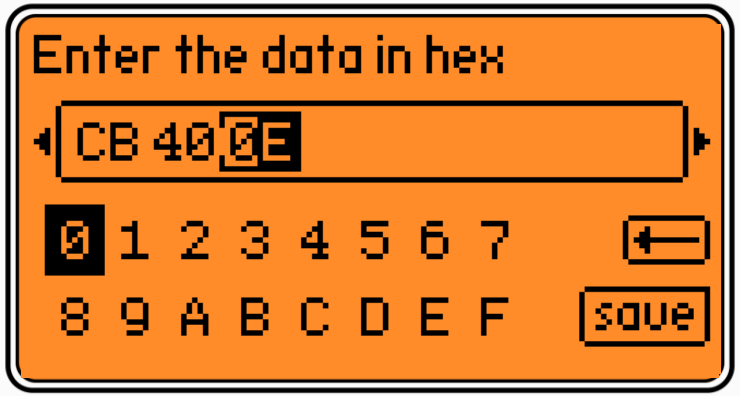
Flipper Zero – Downgrade Attack

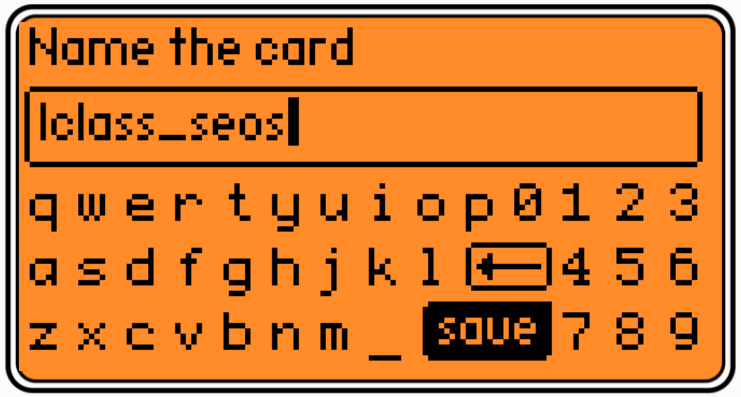


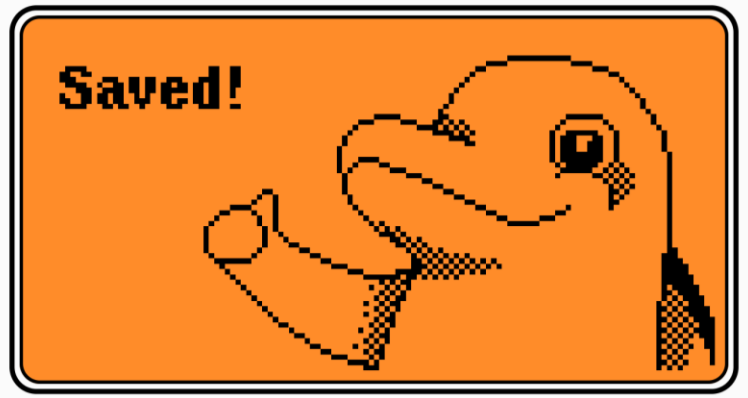




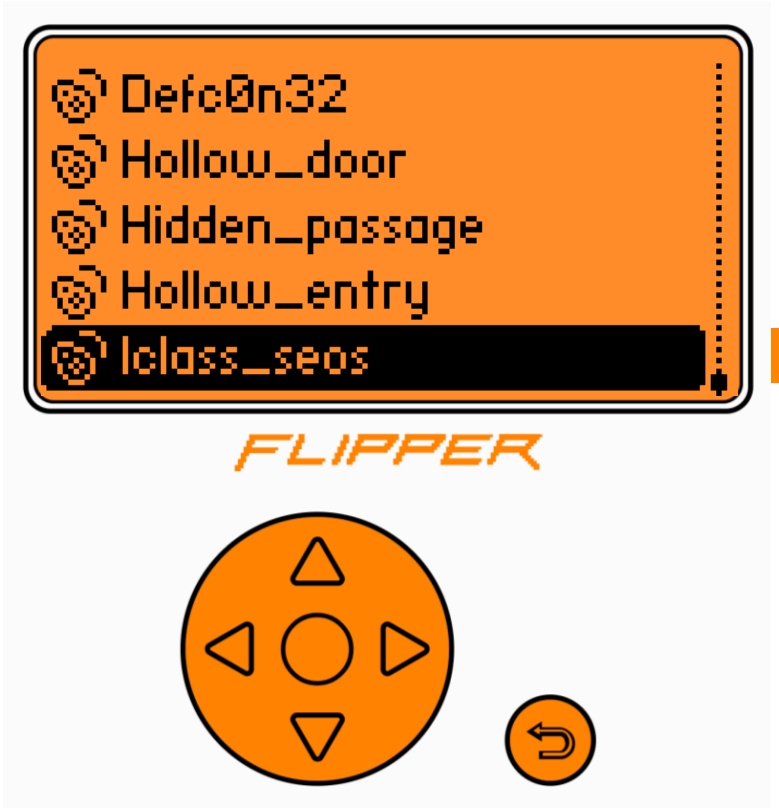
Flipper Zero – Saving Downgraded Card

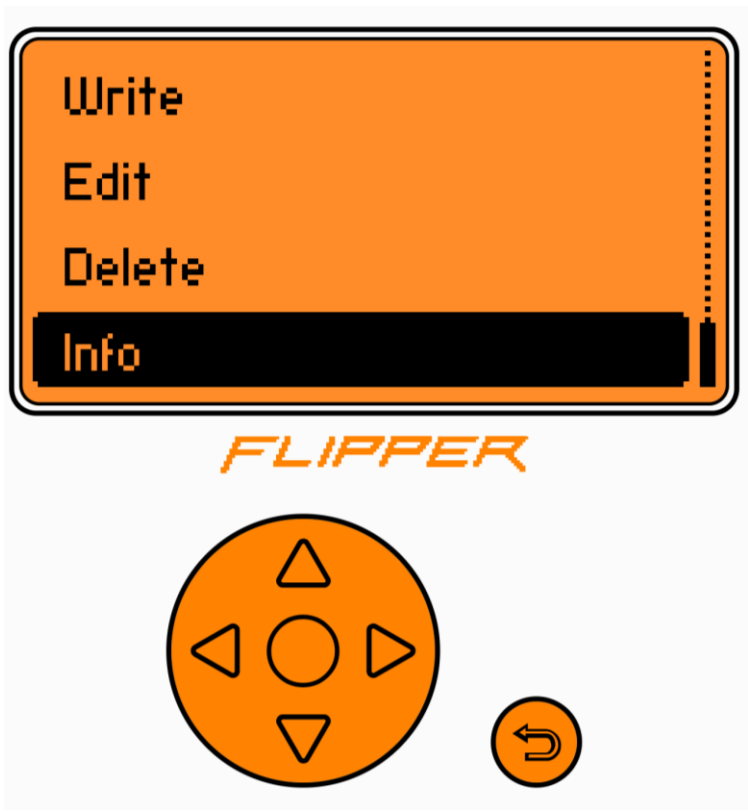


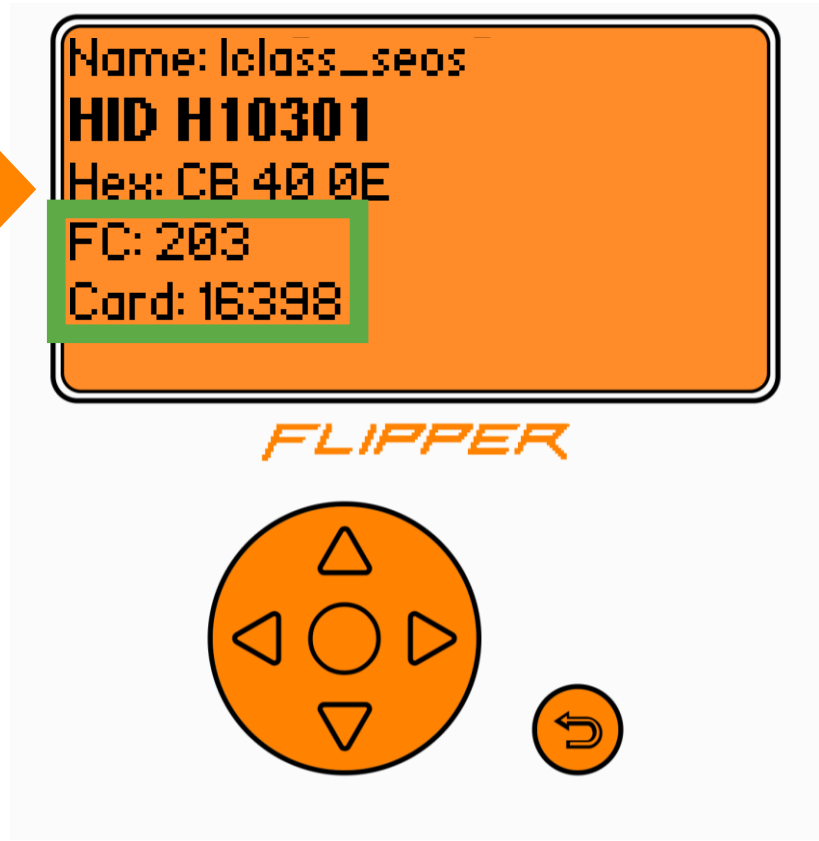




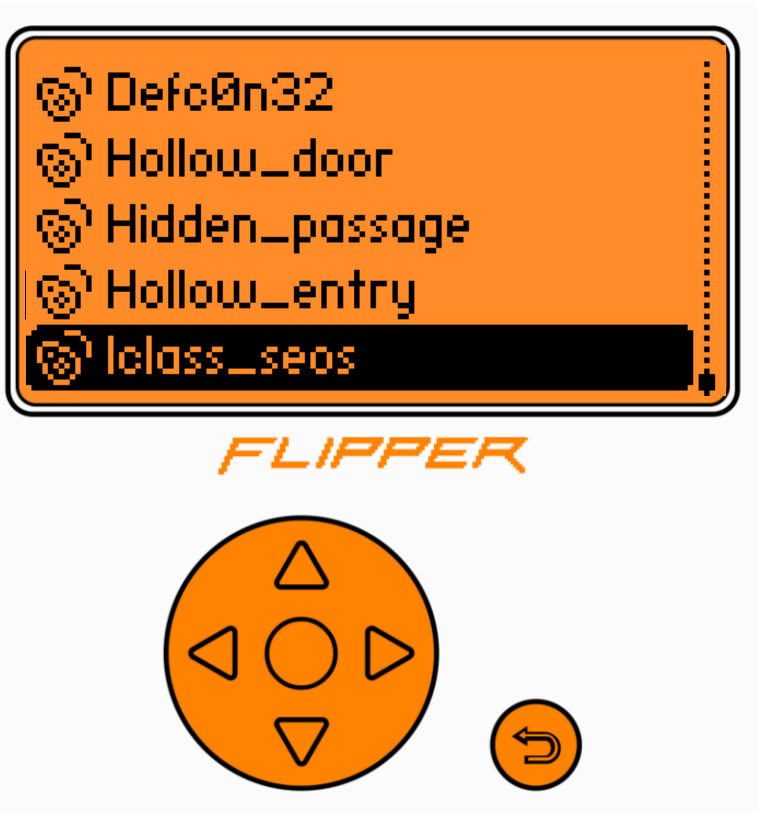
Flipper Zero – Reading Card Info

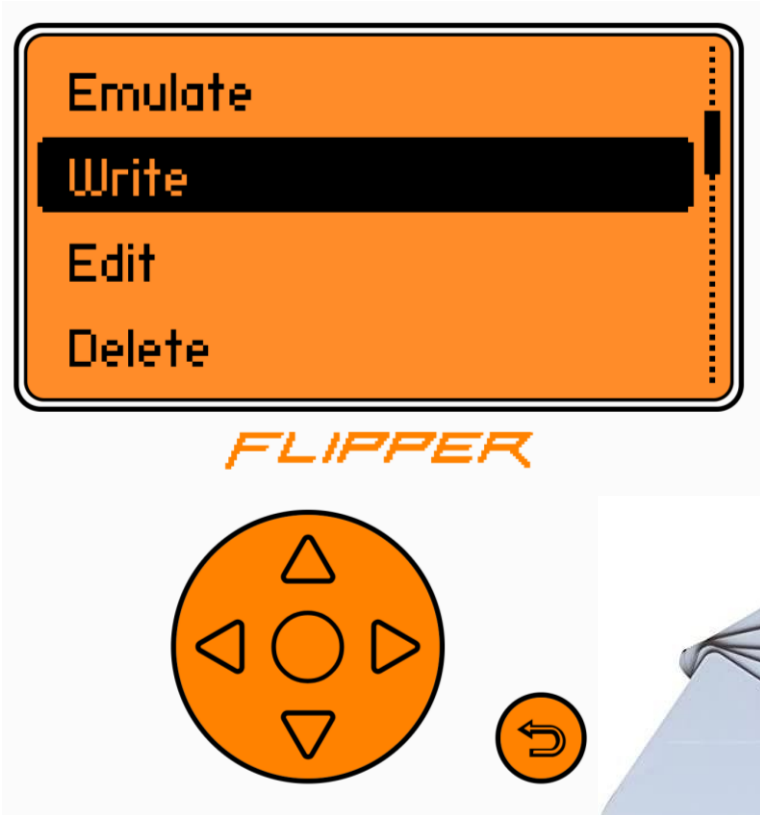


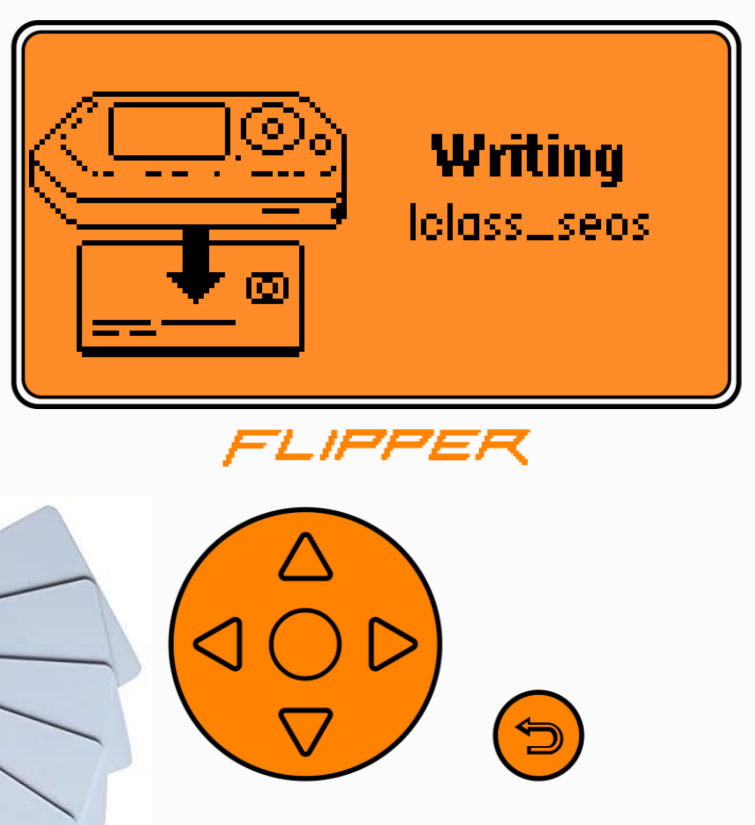




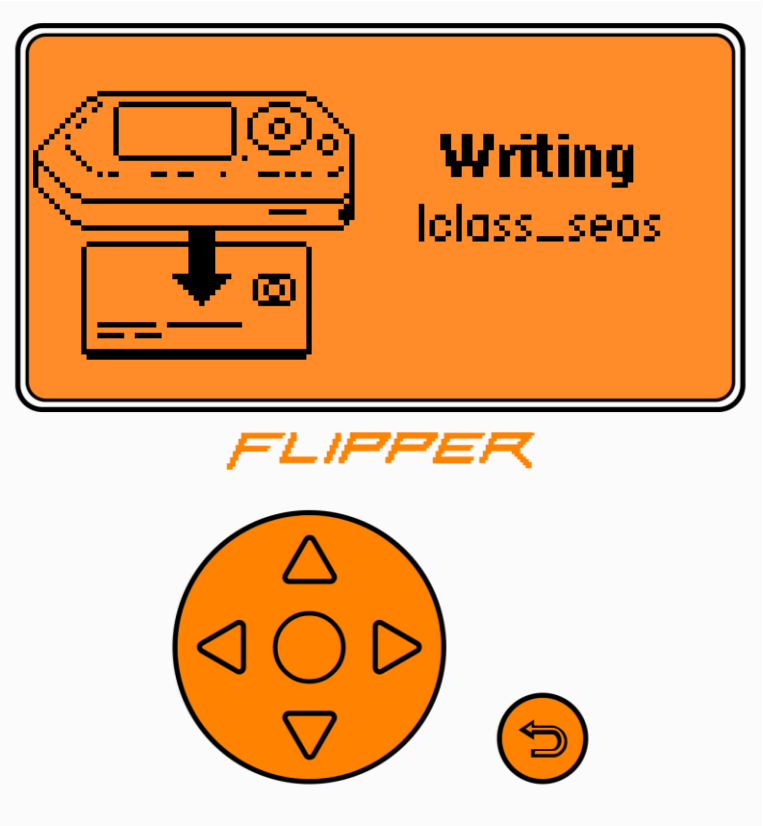
Flipper Zero – Writing Card To Low Freq Badge

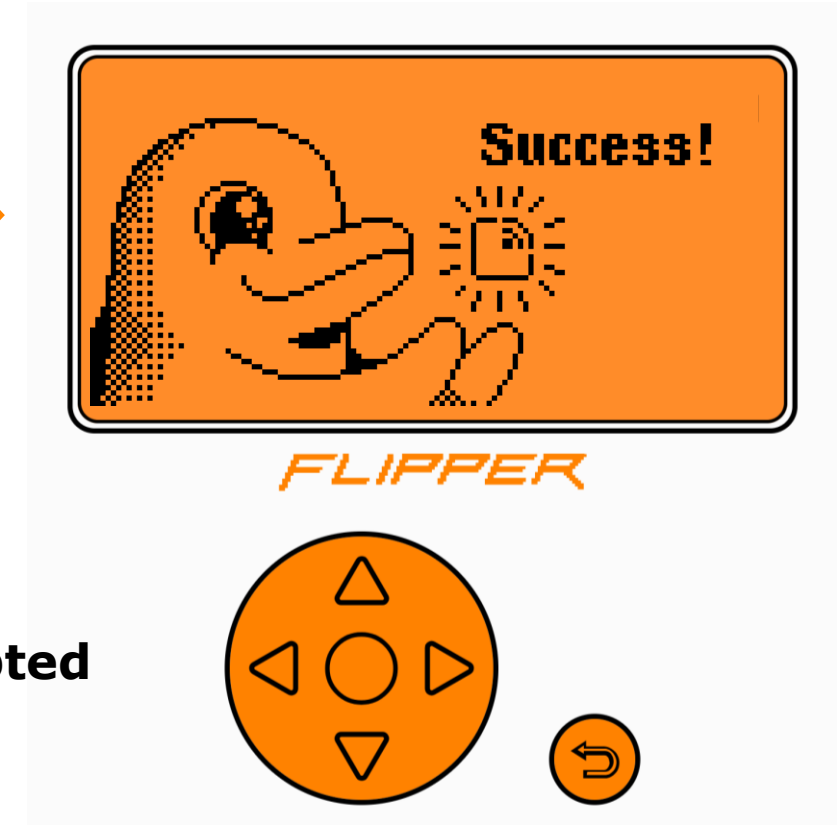






Flipper Zero – Downgrade Complete!



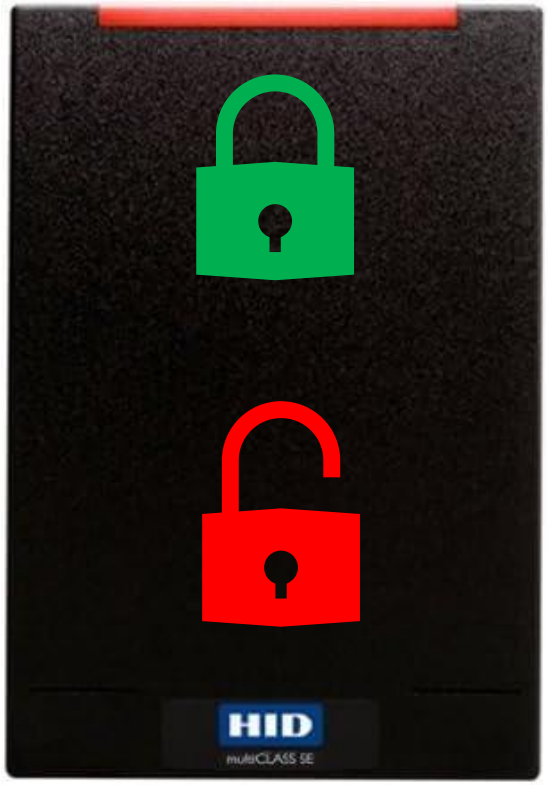


Low Frequency/Non-Encrypted
TM5577 Blank cards

HID SE/SEOS Downgrade Attack

FC = 208 | Card No. = 16398

FC = 208 | Card No. = 16398



HID multiCLASS SE

Flipper Zero – Downgrade Attack Complete!

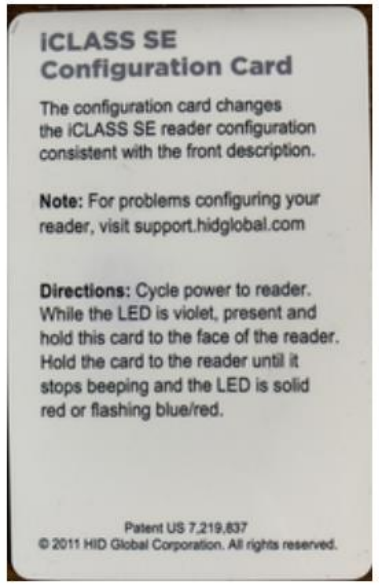
Present the Low Frequency card back to an

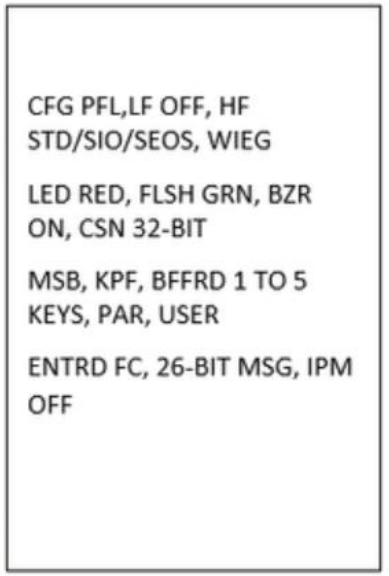
iCLASS multiclass SE reader ONLY!

Mitigations

1. Disable Low-Frequency with iCLASS configuration cards (may require power cycle of each unit)

2. Replace all readers to iClass SE readers, get rid of older multiCLASS readers.





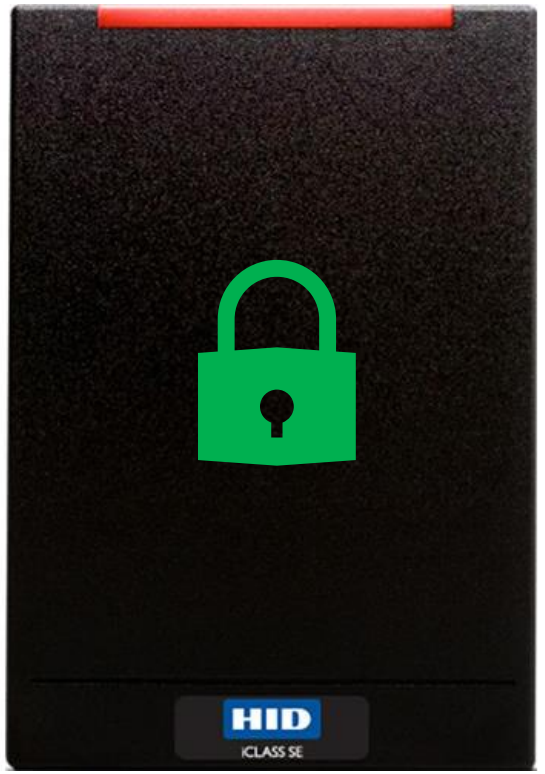
Source: https://tinyurl.com/bdh89zcp

#2
HID SE/SEOS Legacy Attack

Clone using an i-CopyX and an iCS card!

HID SE/SEOS Legacy Attack

- iClass SE/SEOS ONLY
- Downgrade Attack won't work because it can't read unencrypted cards
- Cannot Copy SE cards 1:1



HID iCLASS SE

~~125Khz (Unencrypted)~~
13.56hz (Encrypted)

HID SE/SEOS Legacy Attack – iCS Cards

- Vulnerable to iCS cards and iCS Decoder

"The iCS Decoder **will only work** for target systems that are configured to **accept legacy cards**. **This is the default configuration.**

This technique will not work on all iCLASS SE readers. Coverage is approximate 85%."

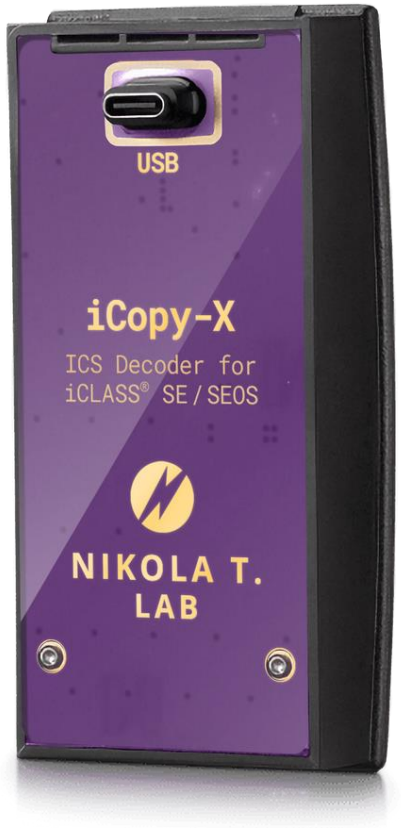
Source: https://icopyx.com/products/iclass-se-seos-decoder

iCopy-X Clipboard Build

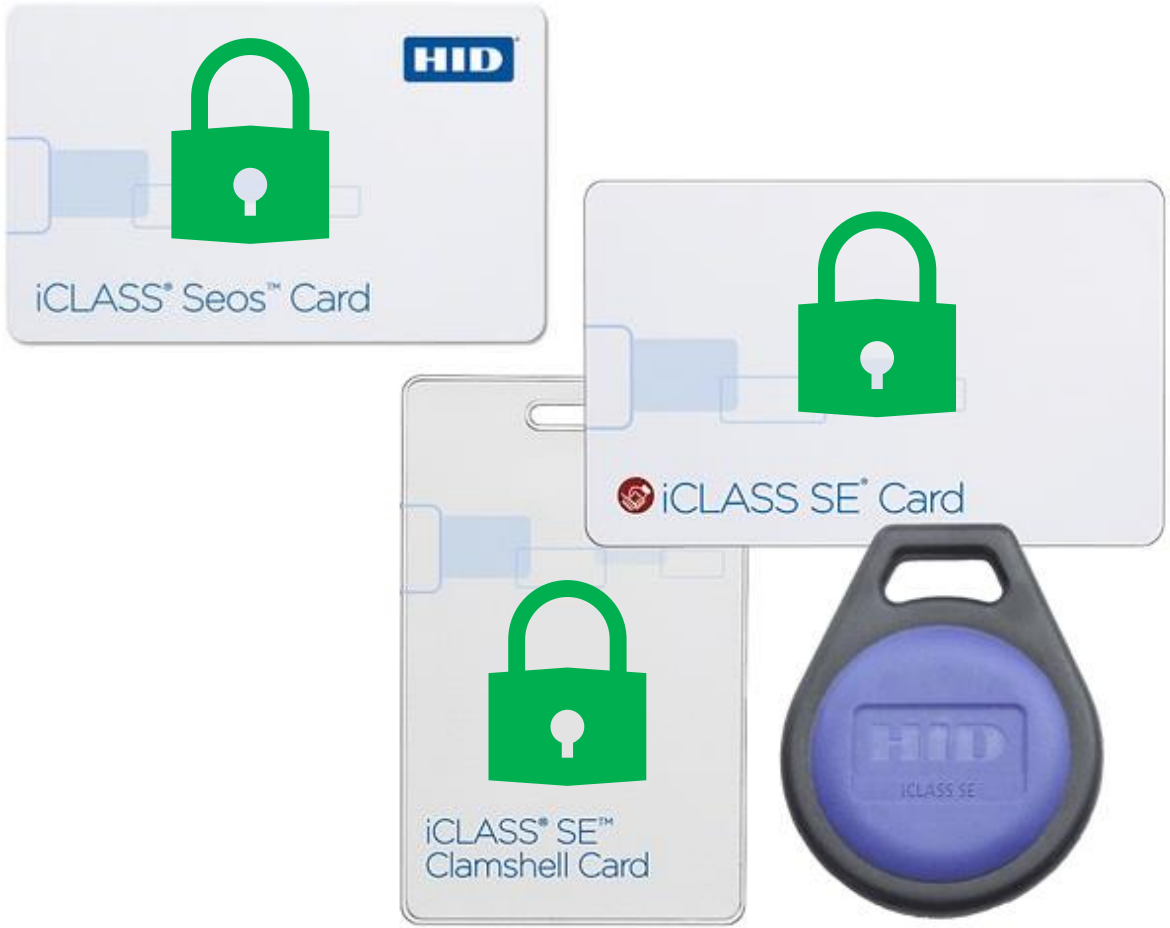
Legacy Attack BOM (Build of Materials):

- **iCopy-X (~$400 USD)**
- **ICS Decoder for iCLASS® SE / SEOS (~$460 USD)**
- **iCS cards (~$20 each – one time use!)**
- 3M Wall Hanging Strips
- Officemate Super Storage Supply Clipboard Case

Full Clipboard Cloning build tutorial guide:
http://www.github.com/sh0ckSec/ClipboardCloner



HID SE/SEOS Legacy Attack



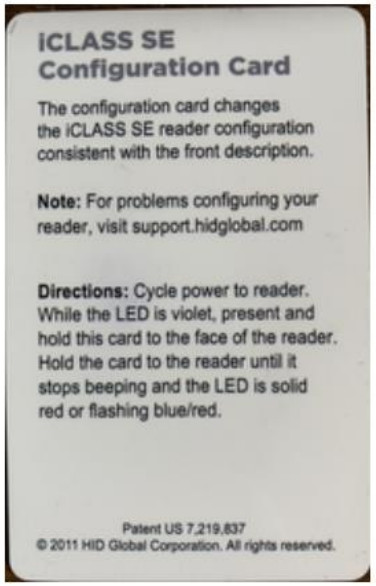
HID SE/SEOS Legacy Attack

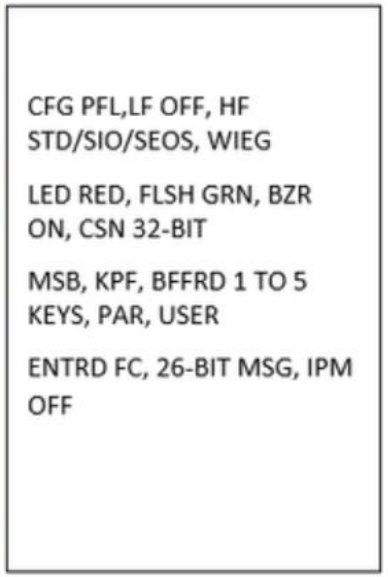
And you're in!

Legacy Attack Mitigations

1. Disable Legacy Card Authentication (the default) with a configuration card.

Source: https://tinyurl.com/bdh89zcp





Other Long-Range RFID Readers

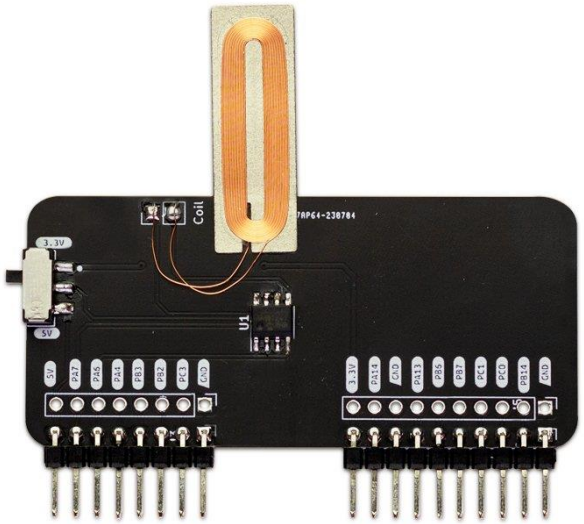
Test out different setups for your target environment!

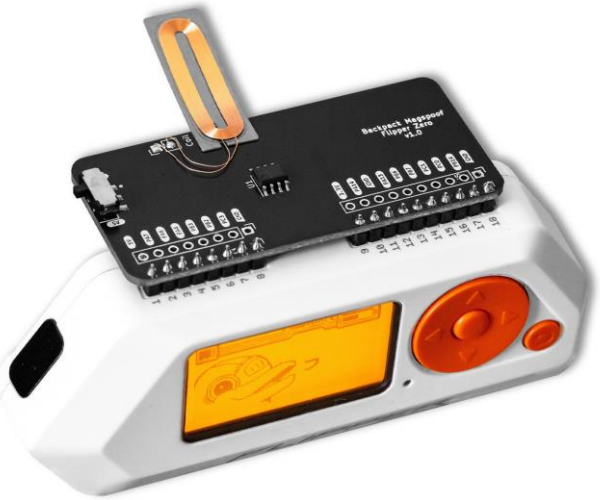
DL533N XL
LibNFC-Compatible Long-Range RFID Reader / Writer.

ASR-620++
Indala Long-Range Proximity Reader

Other Tricks

Test out the Magspoof adapter for Flipper Zero for MagStripe cards



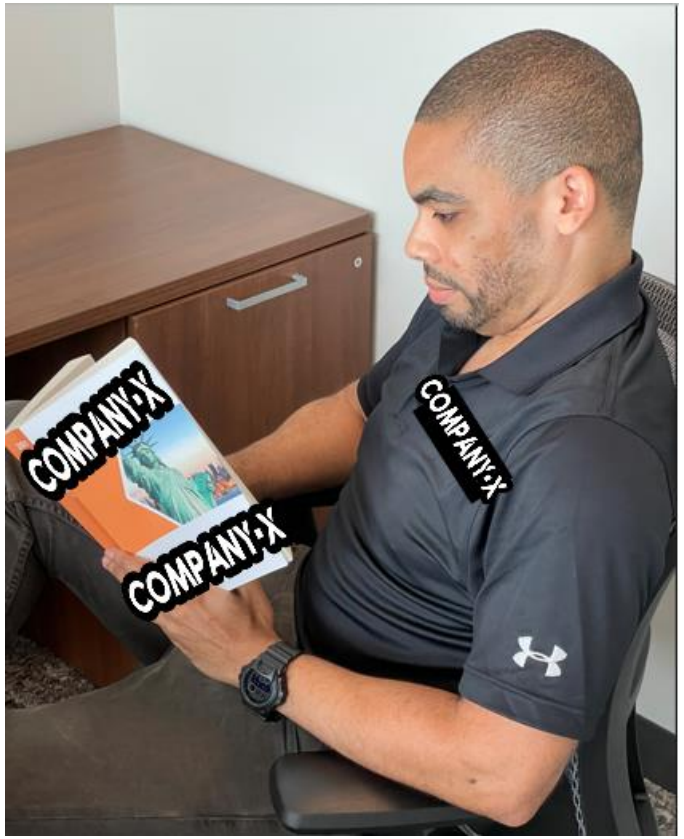


https://electroniccats.com/store/flipper-add-on-magspoof/

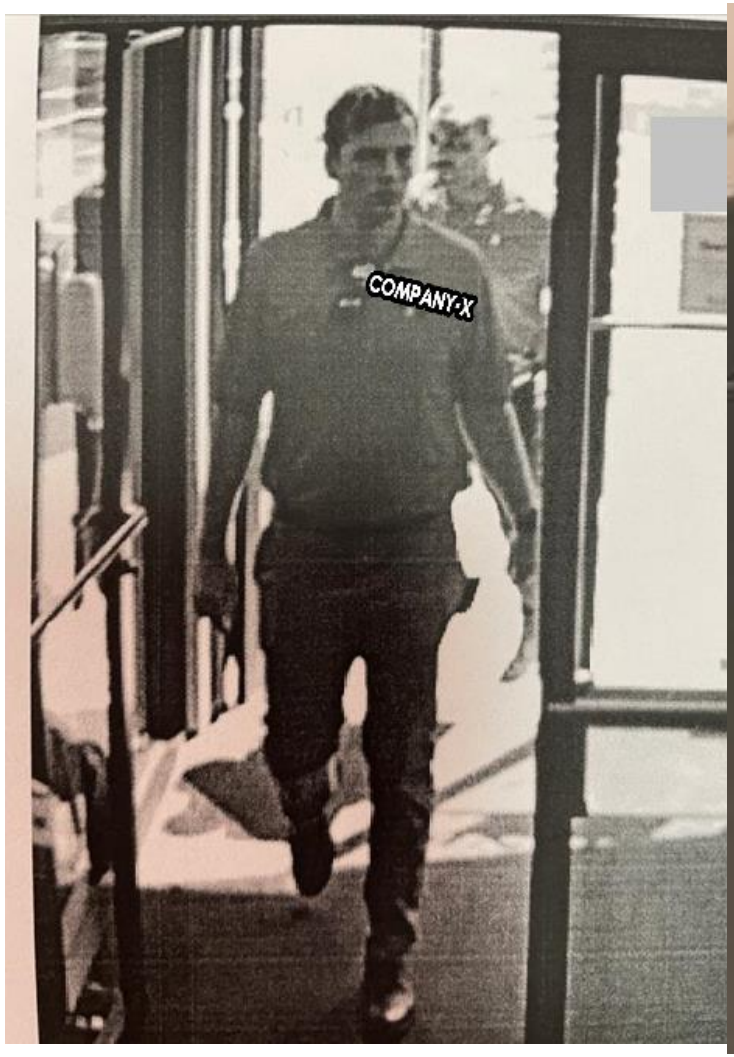
Stories in the Field

CORE BTS

AS SEEN IRL...



AS SEEN IRL…



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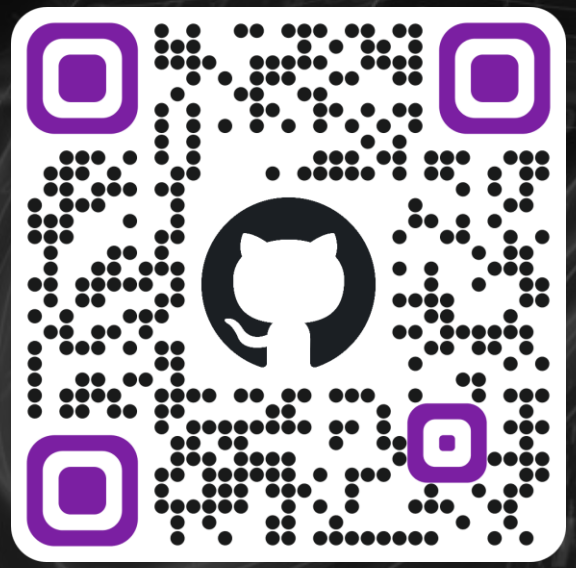
Questions?

Thank You!



@sh0ckSec

Github.com/sh0cksec

@_BadCharacters

Badcharacters.io

CORE BTS