# HOW TO BUILD YOUR OWN COST EFFECTIVE PORJECT 25 SCANNER
## (Law Enforcement/Fire/EMS)

# TABLE OF CONTENTS

# MICHIGAN & PROJECT 25

Scanning used to be easy.  Then, trunking technology took over.  This is not a bad thing as it uses the frequency spectrum more efficiently.  However, it does mean that you might be faced with an equipment upgrade, and it can get costly depending on how you do it.

The state of Michigan implemented Project 25 Phase 1 a while back.  It looks like Phase 2 is still a ways off.  In the meantime, getting a Project 25 Phase 1 capable scanner can cost upwards of several hundred dollars.  There are some alternatives out there that can be rather cost effective by comparison if you are willing to put in the work.  Check out the Do-It-Yourself section!

# FREQUENCY IDENTIFICAITON RESOURCES

[Radio Reference](https://www.radioreference.com) is a great resource to use for figuring out who is using what frequency in your area.  The site has information on licensed usage of the frequency spectrum, organization names, and user submitted information for talkgroup ID's and descriptions of what they cover. There is plenty of information to look at and it is pretty easy to use.  Check it out!

# DO-IT-YOURSELF: TRUNKING SCANNER

## INTRO

Building your own trunking scanner can be done with some off-the-shelf hardware, free software, a bit of Linux experience, and a bit of patience for the tuning. A working proof of concept is possible with the following:  A Raspberry PI, an SDR antenna, USB connection, and a speaker.  Although it does require Internet access to get set up (installation of software), it does not require it to run.  This guide helps you get the right hardware.  There is a configuration section, but depending on your skill level it can be a bit tricky.

### HARDWARE

You will need a fully functioning Raspberry Pi model 3B or later.  The current model is a Raspberry Pi 4, which should be plenty powerful enough to do the trunk scanning.

### HARDWARE LIST

1. Raspberry Pi 4, 2GB Memory Minimum (aka Pi4)
2. MicroSD Card, 16 Gig Minimum (Suggested Class 10)
3. Pi4 Power Supply
4. Pi4 Case
5. Pi4 Heatsinks
6. Pi4 Cooling Fan
7. Micro HDMI Cable (HDMI Micro to Regular HDMI Adapter cable)
8. RTL-SDR RTL2832U/R820T2-Based SDR
9. SDR Antenna
10. USB Extension Cable A-Male to A-Female (**OPTIONAL, NOT REQUIRED**)

CanaKit Custom Kit

https://www.canakit.com/raspberry-pi-4-custom-kit.html

This kit is custom, so you can add/remove pieces as you see fit.  At the time of this writing, the MicroSD cards were competitive in price.

This includes the items above (estimated cost $57 as of this writing):

      - [1] Raspberry Pi 4, 2GB Memory

      - [2] MicroSD Card, 16 Gig Minimum

      - [3] Pi4 Power Supply

      - [7] Micro HDMI Cable (HDMI Micro to Regular HDMI Adapter cable)

Case/Heatsink/Cooling Fan

https://www.amazon.com/gp/product/B07D3S4KBK

This includes items above (estimated cost $11 as of this writing):

      - [4] Pi4 Case

      - [5] Pi4 Heatsinks

      - [6] Pi4 Cooling Fan

SDR & SDR Antenna

https://www.amazon.com/dp/B01GDN1T4S

This includes items above (estimated cost $42 as of this writing):

      - [8] RTL-SDR RTL2832U/R820T2-Based SDR

      - [9] SDR Antenna

USB Extension Cord

**(OPTIONAL, NOT REQUIRED)**

https://www.amazon.com/dp/B00NH136GE

**NOTE**: This helps connect the SDR to the Pi4, not required, but nice to have. You may want a longer or shorter version of this, but the link provides a nice description & a picture of what you are looking for.  BE AWARE OF THE DIFFERENCE BETWEEN A 'CHARGE' CABLE AND A 'SYNC' CABLE!!!!  A charge cable only charges with the ~5VDC - and +.  A sync cable has the power AND the data transfer wires as well, so you can pass data.  DO NOT GET A CHARGE ONLY CABLE. Most (but not all) charge only cables are marked that way.

This includes the items above (estimated cost $8 as of this writing):

      - [10] USB Extension Cable A-Male to A-Female (**OPTIONAL, NOT REQUIRED**)

SOFTWARE

RASPBERRY PI OS

Raspberry Pi OS used to be called "Raspbian."  Be aware of this when you do any Internet searches for the operating system.  People still call it Raspbian, so just be aware of that when

you search.  I'm not saying they are interchangeable terms, but people do often use them interchangeably. The current Raspberry Pi OS is version 10.  The author uses Raspberry Pi OS 10 "Lite" which does not include a Graphical User Interface (GUI), so these instructions are based around that.  If you choose to download a different version, such as "With Desktop" or others, these instructions will still work for you.  The reason behind using the "Lite" version is that once this is all set up and running, there is no need for a GUI. The GUI just sits there, running, with nothing to do, soaking up precious Central Processing Unit (CPU) cycles and memory resources. When this is fully functioning, it will be much like an appliance, albeit one that gripes when you shut it down hard by pulling the power out of it.  Be nice, shut it down gracefully if you want to save yourself some work getting it running again...

Get Raspberry Pi OS 10 here (Recommended "Lite" version)
https://www.raspberrypi.org/software/operating-systems/#raspberry-pi-os-32-bit


OP25
Op25 is free and open-source software maintained on github by a couple of people who really like scanning.  It is a project 25 phase 1 capable scanner, and can even handle a few project25 phase 2 operations.  If development stays active, it will only keep getting better.

Get OP25 "boatbod" here:
git clone https://github.com/boatbod/op25

## CONFIGURATION
Configuration takes a bit of Linux skills and some trial and error, depending on your individual SDR choice.  The NooElec SDR referenced above is only one of many options that will work for this.  The instructions I followed were based on this tutorial.  It is a bit dated, but is otherwise one of the best ones out there:
https://www.hagensieker.com/wordpress/2018/07/17/op25-for-dummies

I did do a few things differently, and I'm happy to discuss, show, teach, and even help troubleshoot as time allows.  I try to make it to all of the Monday meetings as much as I can. Stop on by and feel free to ask about it if you would like some help.

I also have an "Ansible" playbook that basically sets this entire thing up for you.  If you get completely stuck, bring your stuff to one of the meetings and I can run the configuration software tool to get things working for you.  Beware though, it requires a complete wipe and reinstallation of your RaspberryPi OS so be prepared for that.

As always, if you find a better way of doing something or have ideas for improvement, I'm all ears!

Thanks,
-KE8MSW