

Ultrasonic Transducer Resonant Frequency Scanner - User Manual

Overview

This sketch turns your SEEED Xiao RP2040 Connect into a precision ultrasonic transducer analyzer. It automatically scans frequency ranges to find resonant peaks, displays real-time results on an OLED, and measures current consumption via ACS712 sensor.

Because an ultrasonic transducer operates best on narrow bandwidths, the scans of frequencies will be slow! Be Patient.

Hardware Requirements

- **SEEED Xiao RP2040**
- **128x64 OLED Display** (SSD1306, I2C)
- **ACS712 Current Sensor** (any variant)
- **Push Button** (for band selection & control)
 - **Ultrasonic Transducer** (under test)

Operation Guide

1. Startup & Band Selection

- **Power on** → Band selection menu appears
- **Short press** START button → Cycle through frequency bands:
 - 20-45 kHz
 - 46-65 kHz
 - 66-85 kHz
- **Long press** (>700ms) → Select current band

2. Running a Scan

- Press START button to begin two-phase sweep:
 - **Coarse Phase**: Scans entire band with 100Hz steps
 - **Fine Phase**: Refines peaks with 5Hz precision
- Real-time frequency and current displayed during scan

3. Results Display

After completion, shows:

- **Primary resonant frequency**
 - **Peak current (I_{pk}/I_{pp})**

- **Secondary harmonics** (if detected)
- Press **START** to reset and run new scan

Technical Specifications

Frequency Ranges

- **Band 1:** 20-45 kHz
- **Band 2:** 46-65 kHz
- **Band 3:** 66-85 kHz

Measurement Parameters

- **Coarse step:** 100 Hz
 - **Fine step:** 5 Hz
- **Samples per frequency:** 10-20
- **Stabilization delay:** 15ms

Current Sensing

- **ACS712 sensitivity:** 66mV/A (configurable)
- **ADC resolution:** 12-bit (4095 counts)
 - **Reference voltage:** 3.3V

Calibration Notes

ACS712 Variants

Adjust `ACS_SENSITIVITY` for your sensor:

```
#define ACS_SENSITIVITY 0.185f // 5A module
#define ACS_SENSITIVITY 0.100f // 20A module
#define ACS_SENSITIVITY 0.066f // 30A module (default)
```

Debug Mode

Enable detailed serial output:

```
#define DEBUG 1 // Change to 1 for verbose logging
```

Troubleshooting

No OLED Display

- Check I2C address (default 0x3C)
- Verify SDA/SCL connections to A4/A5
 - Ensure 3.3V power to OLED

Inaccurate Current Readings

- Verify ACS712 wiring and power
 - Calibrate sensitivity constant
 - Check transducer connections

Applications

- Transducer characterization
 - Quality control testing
 - Impedance matching
 - Frequency optimization
 - Research & development