# Operation

A graph of a number of lines

AI-generated content may be incorrect.A graph with a line

AI-generated content may be incorrect.A graph with blue lines

AI-generated content may be incorrect.A graph with blue and orange lines

AI-generated content may be incorrect.

A graph with blue lines

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The TX signal is the scaled integral of the frequency function. The RX signal is a function where at a time t it equals the TX at a time t – d(t) where d(t) is the delay that the signal currently being received had to undergo due to the round trip time. Taking the fft of each cycle gives the slope. Taking the fft of that gives the slope of given points in each cycle, say the bottom, which under certain assumptions is linear (small delays, range is limited anyways).

# Target Specs

* FCC part 15 doesn’t consider CW applications… closest is digital modulation in part 15.247 – max conducted power 1W (30dBm) w max 6dbi antenna gain, so max 36dBm EIRP
* 2400 – 2483.5 GHz ISM band – low regulation, at worst will mess with wifi
* Max 6dbi antenna – keep it directional
* Use microcontroller and DAC (possibly built in) for ramp generation and buffering ADC output
* 500us chirp time, 80MHz sweep
* 10m range in normal operating conditions

# Part Options

1. Microcontroller
   1. STM32F745VGH6
      1. Hopefully this is enough
      2. Has a couple dacs and adcs and prob enough power for FFT and stuff
   2. STM32H743VGT6
      1. More memory and power
      2. 15$
   3. St link
      1. https://www.amazon.com/AITRIP-Emulator-Downloader-Programmer-STM32F103C8T6/dp/B0D22S8WVX/ref=sr\_1\_3?crid=379KZ2LUROW71&dib=eyJ2IjoiMSJ9.sEQtkOhqydMVtfKdWfhqLMA-BV8Lfrk2pGMZLmDvwbEH59Xj1NidkfWhPLRXnD0Rg4hVmfYNludqr-jgD2z48pI-XBjLDNsTmZ4H1sT7rF3hSfQVHPjP3lMN\_BtXRsyGj0gaxlYZBh-CtiprDpS66\_n1Krusi83\_DiXxcYJ1AyZjtaeba4Hjxufdx6nkonWBfQ-5lqD2MKNAo6Vho0VowKCcFeua-p1RIXH8OUW7qRZrVcShD98ong3JWiRZBk1Nwxilx5XfpC64yW7iMOZZs23M87aYoYZSybB84J09HME.7gy5rNXvRmf\_JlrVY4WfGYTs9uakF2lk1eCHD9sOuwg&dib\_tag=se&keywords=st%2Blink&qid=1748375199&s=electronics&sprefix=st%2Blink%2Celectronics%2C90&sr=1-3&th=1
2. DAC
   1. On MCU
3. VCO
   1. Crystek CVCO33BE-2400-2500
      1. 0-3VDC tuning
      2. 2.4-2.5GHz
      3. 55MHz/V sensitivity
      4. +1dBm Typ output power
      5. -116 dBc/Hz at 100kHz offset
      6. 25$
   2. MAX 2750
      1. 0.4-2.4V tuning
      2. 2.4-2.5GHz
      3. ~50MHz/V sensitivity
      4. -3dBm output
      5. -95dBc/Hz at 100kHz offset
      6. 9$
4. RF connections for pcb
   1. Sma to nM x2
      1. Cinch Connectivity 29 3840
         1. 9$
      2. RF Industries RSA 3453 or 3478
         1. 10$
   2. Sma through hole x2
      1. Gradconn RFPC SMA 28 F
         1. 2$
   3. Sma m to m barrel
      1. RF solutions ADP-SMAM-SMAM90
         1. Right angle
         2. $5
5. Splitter
   1. Mini circuits ZX10-2-332-S
      1. 46$ Yikes
   2. BD 2626
      1. $2
   3. Make one yourself
      1. Bunch of resistors and stuff
      2. 10$?
6. PA
   1. BeRex BG13D
      1. 21.5 dB gain
      2. P1db 19
      3. 3$
   2. Skyworks SKY65900-11
      1. 34dB gain
      2. P1db 34 dBm
      3. $2.5
7. Antenna
   1. FMANLP1009 x2
      1. 10 dBi gain
      2. 50 deg beamwidth
      3. 16$
      4. Female n connector
   2. Make own
8. LNA
   1. https://www.digikey.com/en/products/filter/rf-amplifiers/860?s=N4IgjCBcpgzAnFUBjKAzAhgGwM4FMAaEAeygG1xYAGKsKkIsAJnngBYmHwX2A2L5qwCs-Rj16jurABywBPaZMHxp0%2Ba3gB2LtLZsh8CGOlC2ktvCYnERTU03xYnY0JbyTTOS6b0XYJUy8mppe3EES8uGhzELMvtyxnlxsmrR2ArzSVCkZWRa52UqZ2ULJqWAhXA4SgckSYPmMxWxG4MWw2k1ZsEXdpV1UsKFCVMFC0cVJA-ZcvPaKOhaadMnwIrzxGxpVvBx6OxxTIFvwm1SsrQawK0RXVJLSFaxsXAYsareuVB8gQl8vnx8wy%2Bly%2Bzl%2BTE8DyW91eLCo4Ncp0u51Ur1RnW4CKo-RAZmWjTxQTApnk2PBvCEmj%2B0R8YFYZPpAVoa0ZljZrTiYGkNhAyxECDZ8S5CyIbCccx%2BIoBIB4PlxVl41ExiuorV0p14vPs1A4XB12XiBtgP2NKpCg1CxvBBsh%2Br%2BjlNDp69quCud4P0DhG%2Bp6qkkUNUvP0KhyREDjzKIzR4b9mh%2B%2BK9vsy6VjKfiKRGvFagcy%2BqYcG%2B%2BrgHVxIUhc2LQzz4ZLIirsFiDbYUukTDYOKqqUbSipCJlJPKvMHtB%2B1O9wo7rhl%2BO%2BrRS7A7AinDVmsD0kaIWtHs2Rkm3YFa29hW9O2V3NE9SsbR557GSErcW7voUyrApPJ5s0-M6Cfx%2Bb6bscPION%2BWhjqcLZGiaLA2jBui%2Bm21KvJoEiEp4bY1niawjDKlKaCkrYcCaAi6O2V78qE4qBLUjBkdcpGHJyZF2ow1GVGxEqSNSBiDMuErRNRQhjqWIk8VUpbgiEBE-LogzLFUozwEqEkEZi0lmFUylKlJ2kdKpS62B0LpGXYAYtgRCoWYKW4ducmIpipW5UikoQhCkR7rhYvKoUMfxcAgfytIFepEIF64BWsTiRa4oSBe2MWjIlagALpEAADgALlAIAAMqZQATgAlgAdgA5iAAC%2BYr6EgICoJAmC4IQJDkOAoyyJy2TxsK5yuLih60CSAh0CwA3%2BDQmKHuuWojT0cBzZ1I3sMEI3ucOFTxuCDT2FYAgmjh%2B2WAWy5zBEbEcD6F1UsOeipFKG4IsumqCcsoGMLEWwCCMPQDqYpi9vMf0mJ2aUgFlOX5cV5VVYwdBqNA9XoNg%2BBEKQkAUAWwQ2giRzts8%2BpyQGQSaeGWombKFpWrIqQBcwC1hQizABaM0VhR2tPs%2BcwXUFdIBDE4MpDI84K-aF-N-KSYUmFkAUhCYy0E2K-5UX8T54ro1BlOu8QjI4uKuLomIWOsMpBUMrzEWbBGUop1Rm5YVKzOc%2BxboMTZbvYLYZMEeZgxDkB5YVpUVdV4B0IgiMNU1qOtRj7XUHxRAqBUCZrJk5hBPZXAqNmvIqLIwbp%2B9IAXK72EiPGAgdQxjAdcJqyV9t3UK2Kxe4ibmTzsXM7p%2Bd4eeIZ2EpOK1drLR7VrCoY-xsO5wrSNQ1KKNWgjRsYbh04e1w0MNybwgUpwB5c1zNEcDy4tbPDwRA5wCo43sI4a3c2t3LChUgS3yErhVJCJKchUbMvdK4AOCLIZcu0HpWBmG3EeU0TQ9X2jyJ2jAEA4m2ggQ8mJMISCUAgaBp0rBTT0E4Yh4ppBkJGANPQwl1TkRQeAR6gkWxYQaBYcWDRTj3jbusYhWpKxsWWK3CuEgHrf09OnWWgjDjLhtlKT6tdGFaFtmxFQJ1VGsHiLoMw6jwA-Seh9QYKi9FemiK4eMvZFAJVsH-fysDghmI2FI44yluRSmzP4XsKdhw6VYm0J4wpsxGyqP9ICOCggZFMMNHh4QMgIAIhkFoCEmghGnk0DYqY%2BTaVHuk94pEEAtF-gWcYjcghTRFpzcAjxiKkTmPWOisRap0U6tERQZEJJMilKca4rQ7DFO2oYR4ZZbFKFOCYaIi4KECC0IMAcuc%2BbVF2DKHwNBGz6loBudZ6DtQNBqMWXYJTawiD8QWMZpofBWHOd2RA-tsqByhiHWG4AVCRxQMjZqaM2r0BSpVMO-BEZFQACY5QALR0FaAHEAXAACOmUACeOVWjwvSngHKGAcCoF%2BUAA
   2. Berex BL022A
      1. 17-18.5 dB gain 2.4GHz
      2. 1.5-1.8 NF 2.4GHz
      3. 3.50$
   3. Qorvo QPL9504
      1. 20-21dB gain 2.4GHz
      2. ~0.5dB NF
      3. No leads
      4. 5$
9. Mixer
   1. MAX 2680
      1. 3$
      2. Active -> -10-0 dBm LO input, and >-25dBm RF input
      3. Not rated to output less than 10MHz
   2. ADL5801ACPZ-R7
      1. 15$
   3. LTC5548IUDB#TRPBF
      1. 25$
   4. TRF3705IRGER
   5. Mini Circuits **ADE-3G+**
      1. $7
      2. Requires input and output match
      3. Requires amplified LO
      4. Overall an extra amp, attenuator, and matching net
   6. Analog **AD8343**
      1. $11
      2. Requires output match
      3. Active, -10dB LO
10. BPF
    1. Walsin RFBPF1608060AAT
       1. 2.4-2.5GHZ
       2. Like $1 for all 3
       3. Very small, like 0.8mm x 1mm
    2. Johansen 2450BP08A0100001T
       1. Same specs
       2. Slightly bigger
    3. Taoglas DBP.2450.X.A.30
       1. 1 db more IL
       2. Much bigger, way easier to solder
11. LPF
    1. Make one yourself
       1. Op amp and stuff
       2. 2$?
12. ADC
    1. On MCU
13. Housing
    1. 3D print or ignore for now…

# Design

To choose the exact output power, we consider that we want as low power as possible (for less heat, oscillation, and saturation risk) while maintaining some amount of range ability. I would like around >=10m of range for a normal target (maybe a car w 10m^2 RCA).

Here, the rows are ranges (1, 5, 10, 15) m, and columns are (1, 10, 40) m^2 RCA. The power levels are conducted.

A screenshot of a computer

AI-generated content may be incorrect.

24-27 dBm conducted power works out. -45 dBm Pr I would estimate to be usable conservatively, given some common LNA and mixer specs. In the 0-2 dBm Pr situation, the mixer risks overloading. The overloading risks looks pretty low though, so we’ll just be careful to keep a good distance.