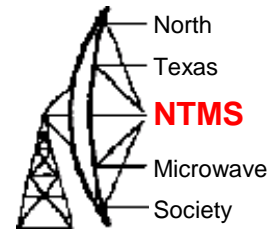
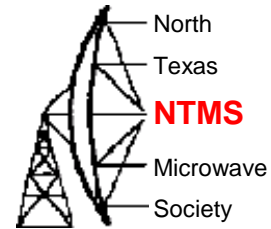


Wavelab 23 GHz ODU
module and PA0MHE
add on board
Feb. 4, 2022

Wavelab module



Wavelab module



- According to Wavelab ODU brochure, frequency range is 21.2-23.6GHz but original PCB LO can't reach 21.2GHz. TR spacing is 1008 MHz

23X1008XP

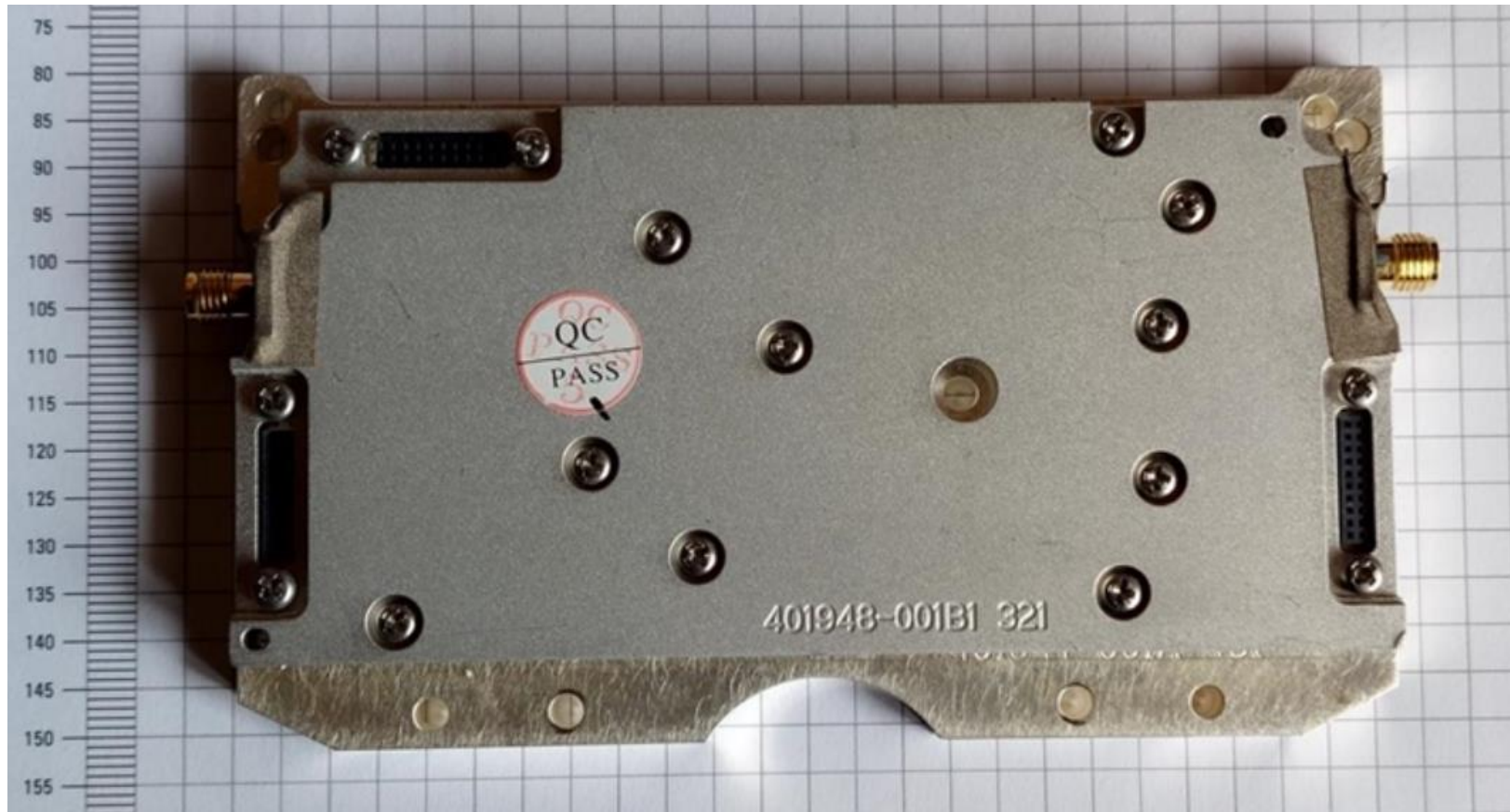
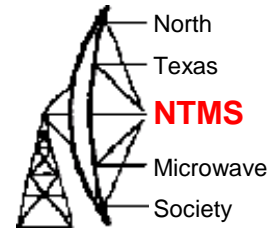
TR space 1008MHz (IF Tx 2364MHz-IF Rx 1356MHz); RX=LO+IF Rx; TX=LO+IF Tx; TX= RX+1008MHz
Motherboard ADF4153 PLL; VCO CRO1728T-LF; LO Range 1670-1770MHz

| Frequency Band* | RX | TX | LO | LO/12 (input) |
|-----------------|-----------|-----------|-----------|---------------|
| 23.600GHz | 22.592GHz | 23.600GHz | 21.236GHz | 1769.66MHz |

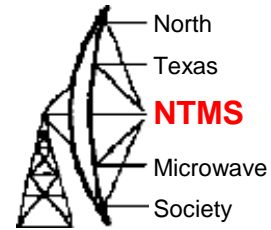
- The plan to put the module on USA terrestrial 24192 MHz

| | | | | |
|---------------------|----------|-----------|-----------|-------|
| Synthesizer 1 ADF 1 | 1819 MHz | x 12 mult | 21828 MHz | |
| Synthesizer 2 ADF 2 | 2220 MHz | | 2220 MHz | |
| | | | 24048 MHz | |
| | | | 144 MHz | IF |
| | | | 24192 MHz | Final |

External view of module

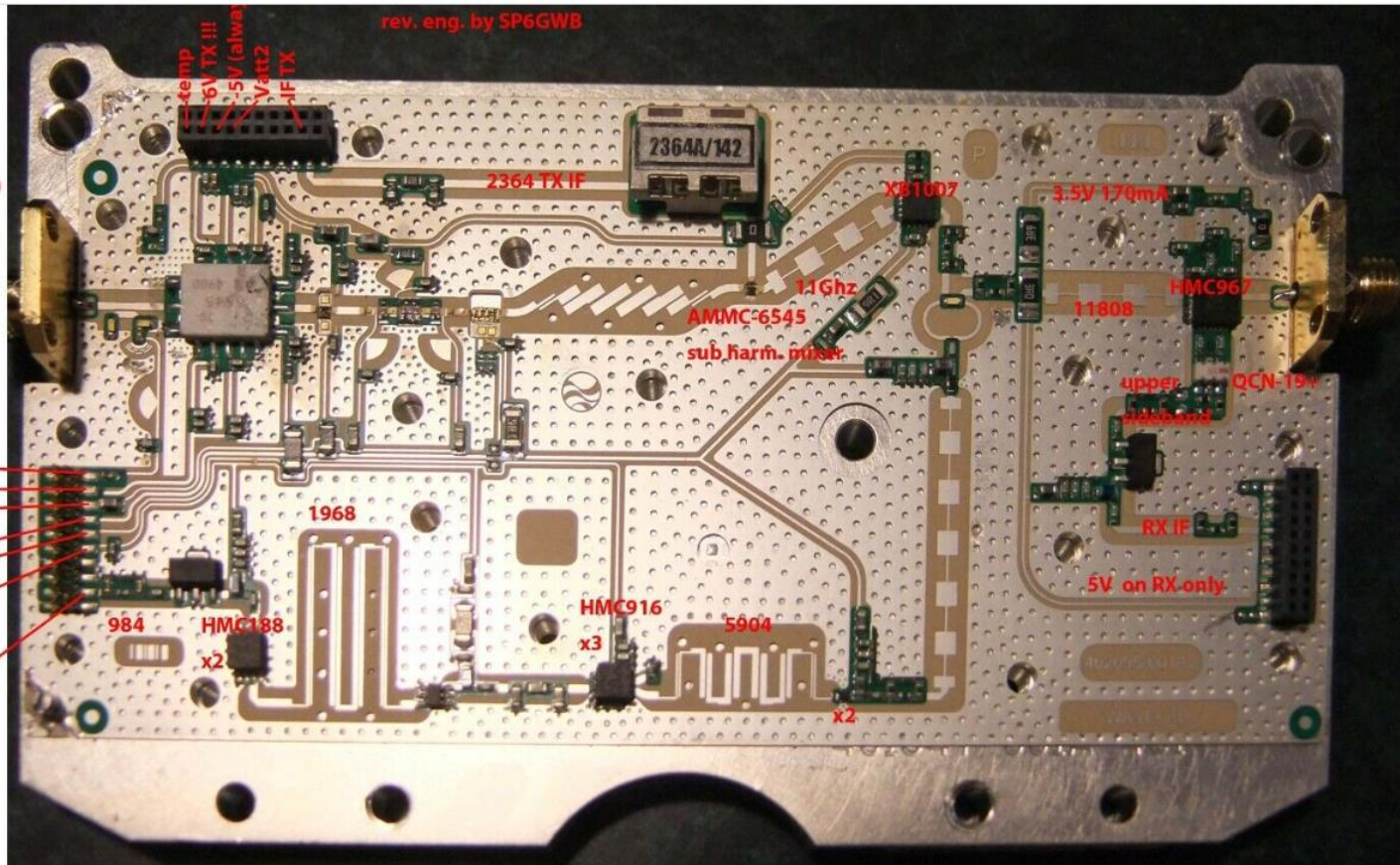


Inside the module

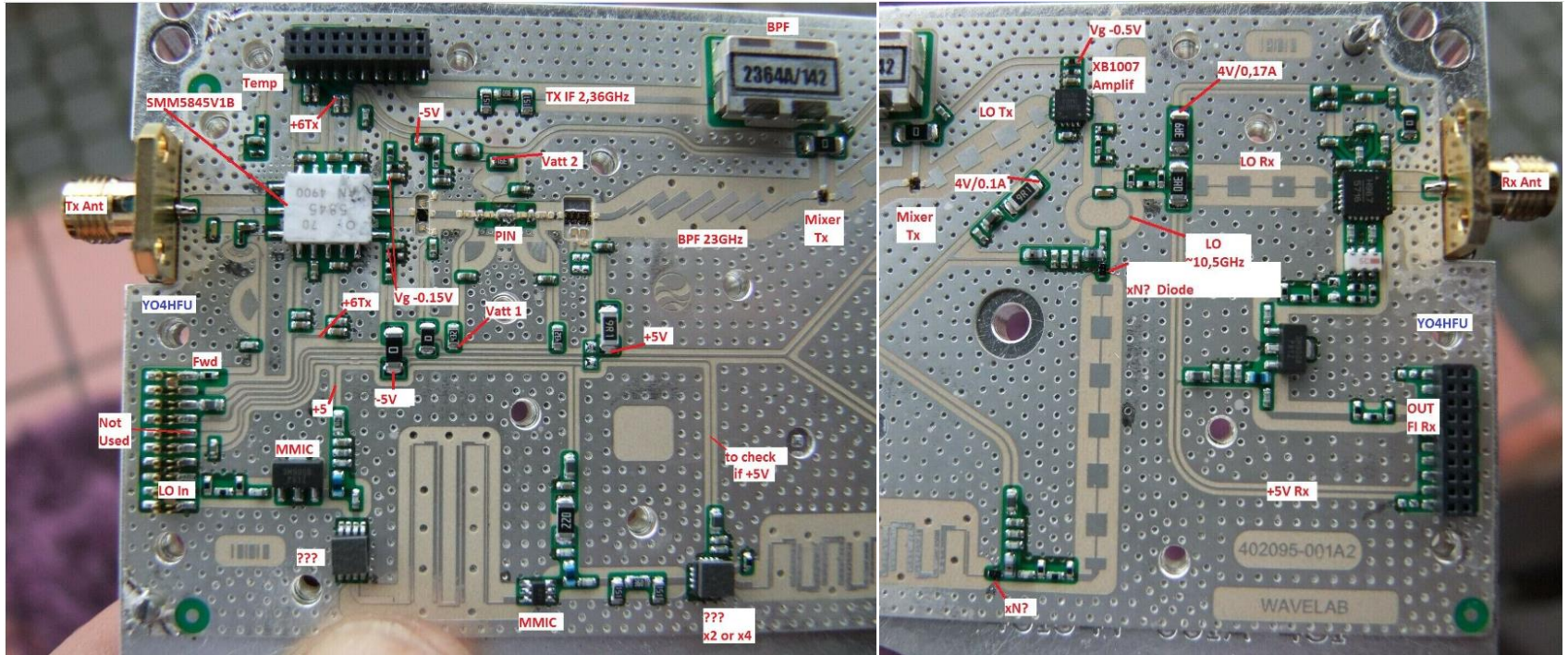
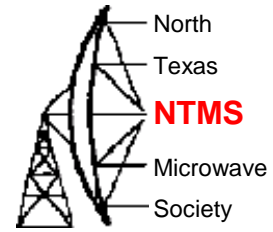


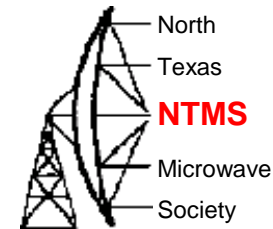
1. **NEGATIVE -5V voltage MUST be always present (also on RX)**
2. **6V and -5V on both connectors must be connected externally**
3. **TRY NOT TO OPEN it is hard to assemble**

- tx mon
- +6V TX !!! 1.4A
- Vatt1
- +5V TX&RX 400mA
- 5V (always)
- 5V TX&RX 275mA
-
- LO IN 5dbm min.
-



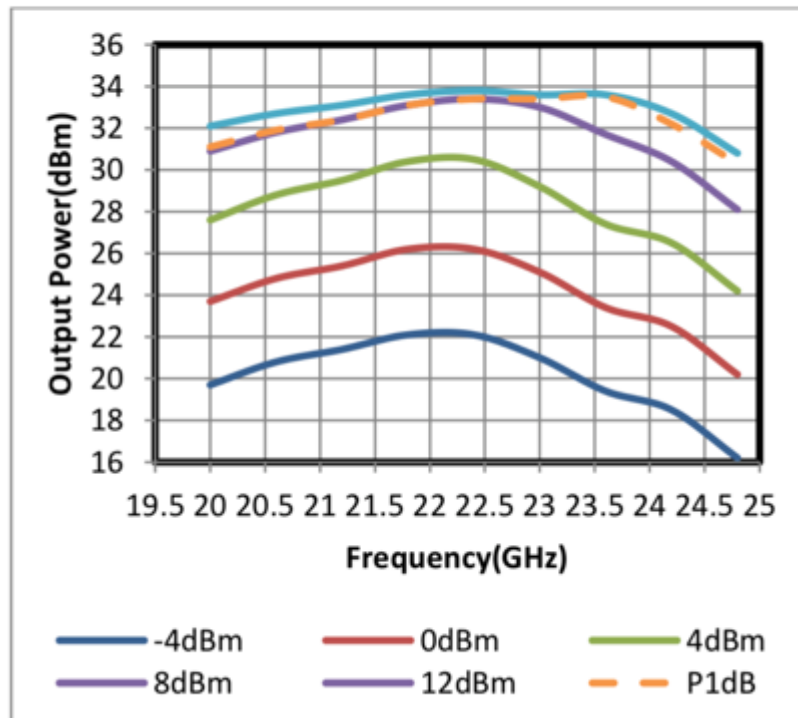
Inside the module



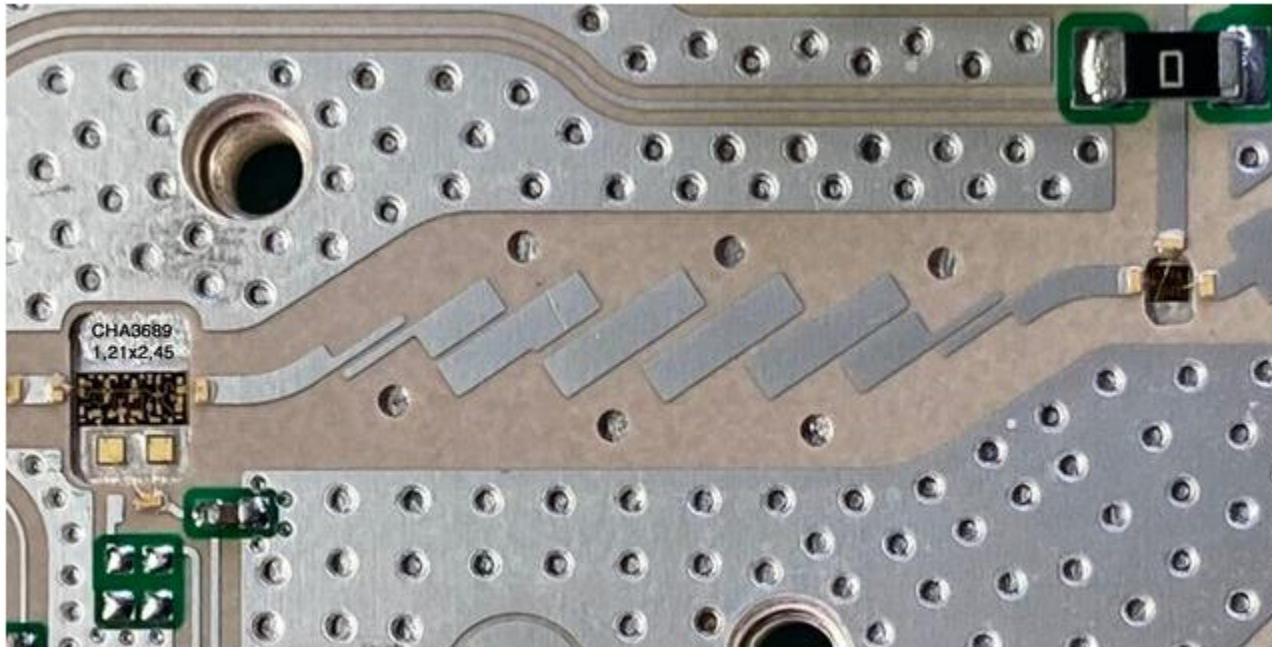
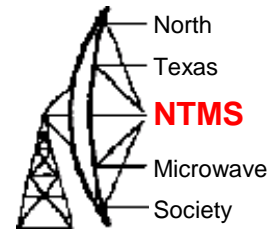


SMM5845

Output Power vs. Frequency
VDD=6V, IDD(DC)=1400mA

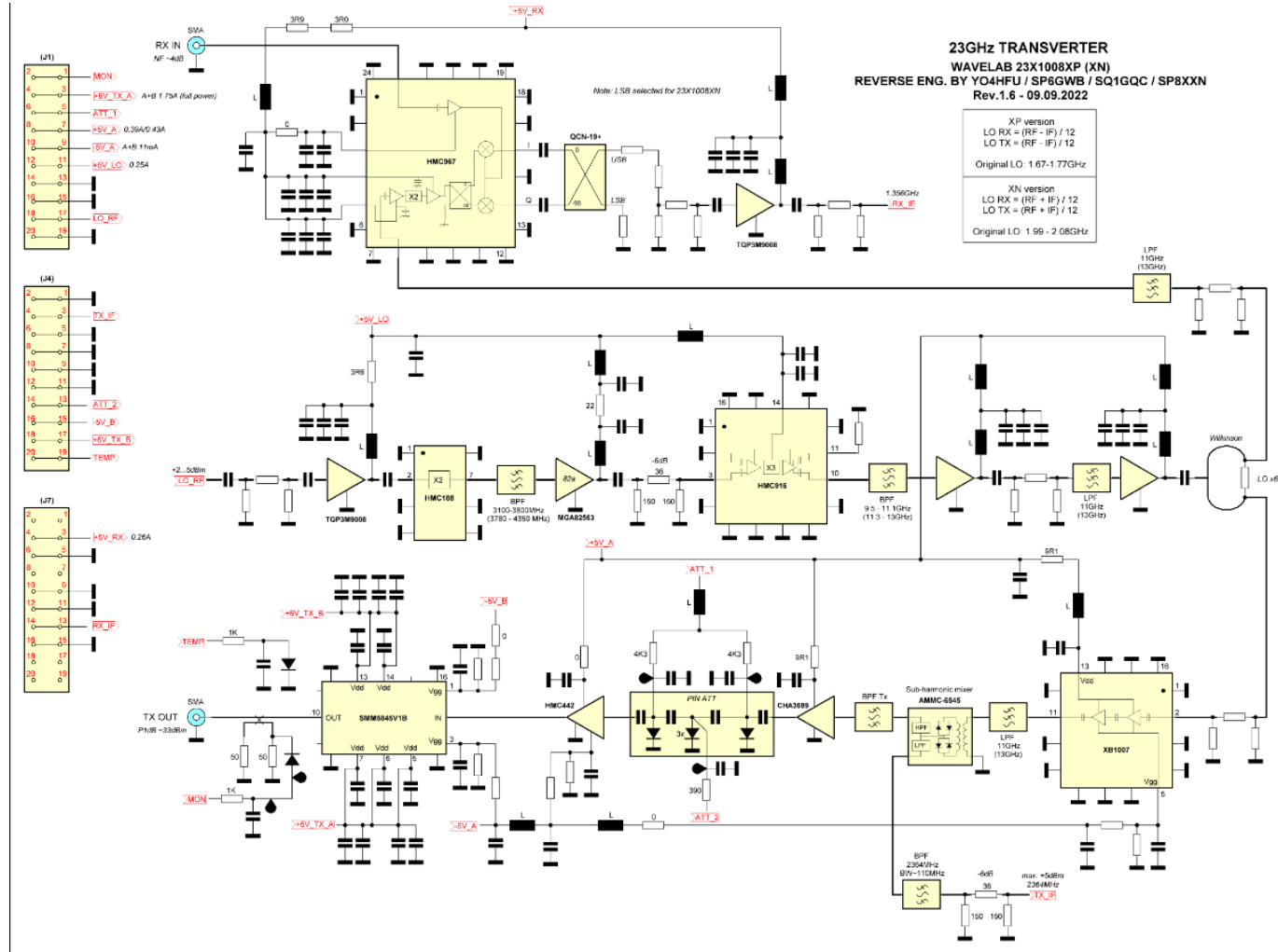
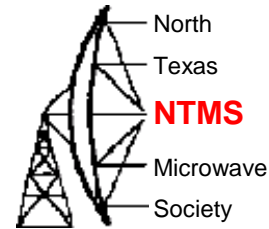


Inside the module

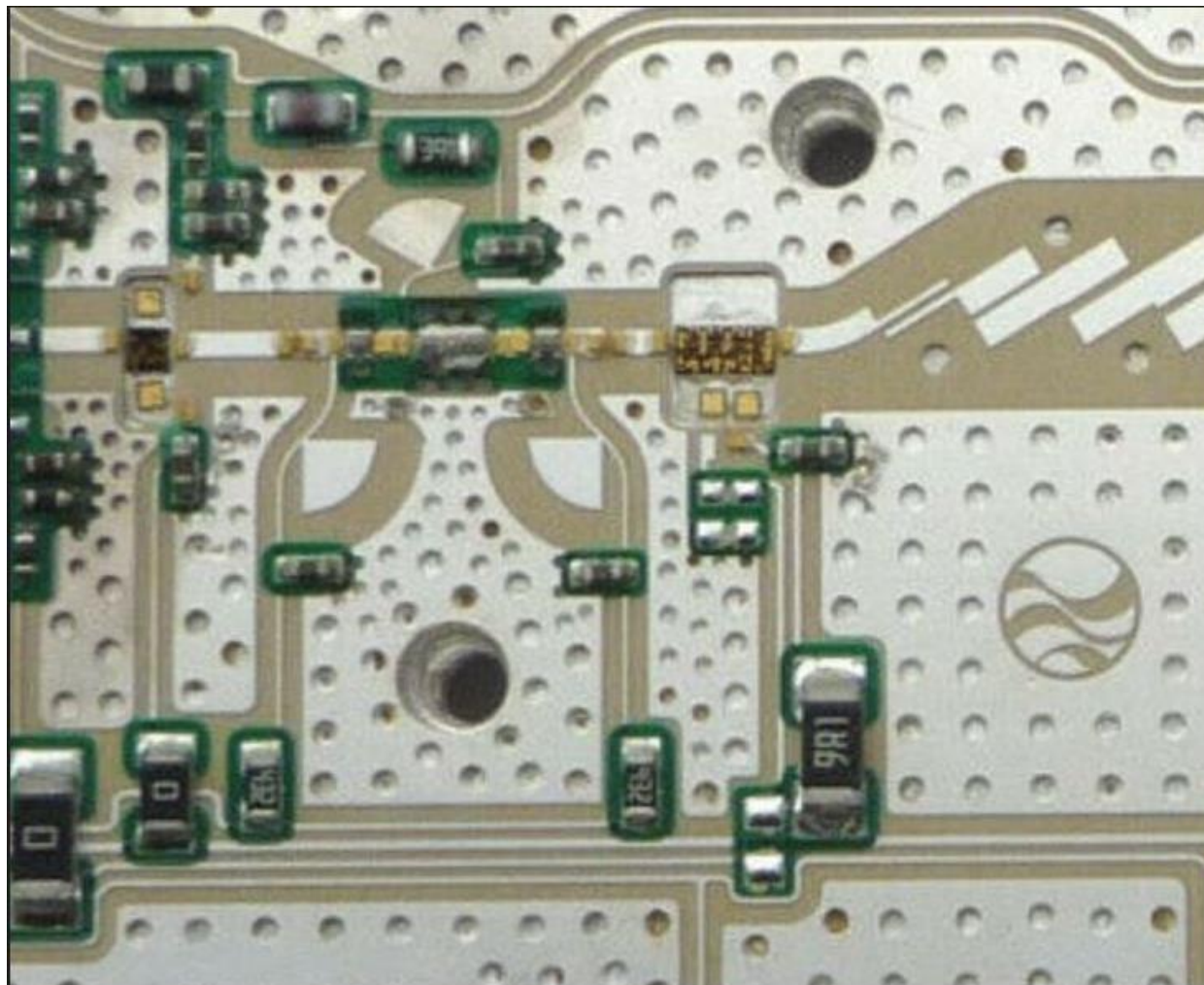
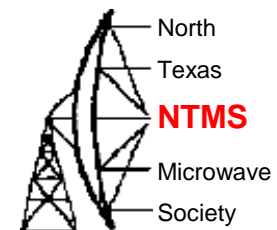


| | | |
|---------------------------------|----------|------|
| $12 \times 1700 + 2364 = 22764$ | | Ref |
| $12 \times 1633 + 2364 = 21960$ | down 804 | -3db |
| $12 \times 1774 + 2364 = 23652$ | up 888 | -3db |
| $12 \times 1807 + 2364 = 24048$ | up 1284 | -6db |

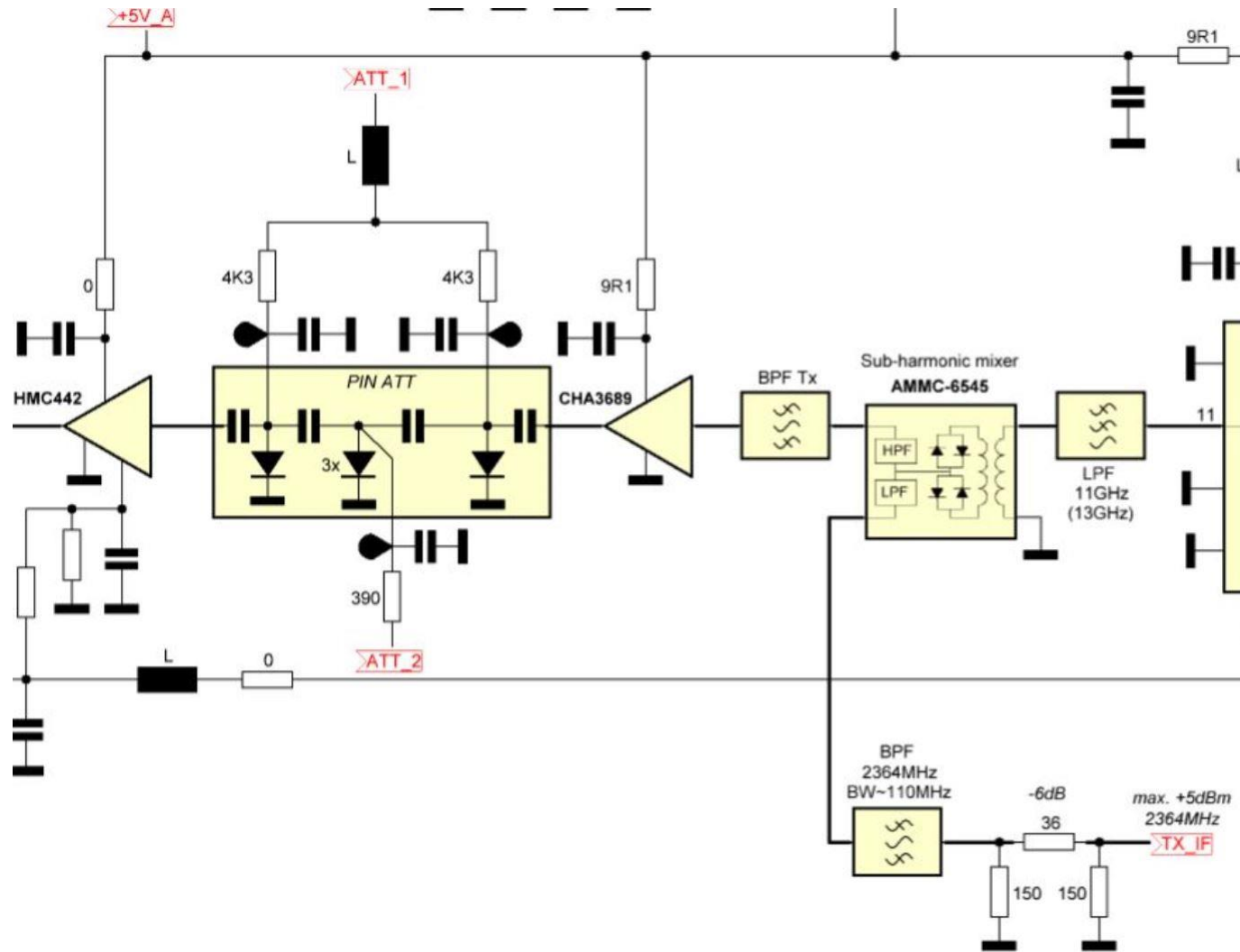
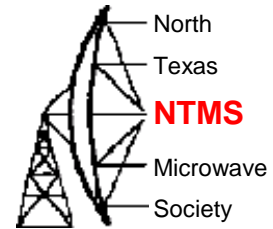
Module schematic



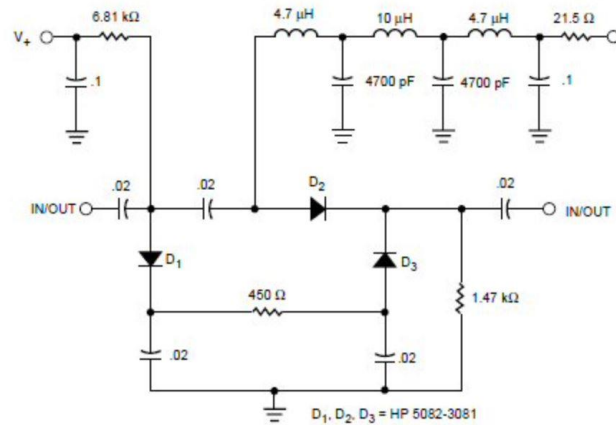
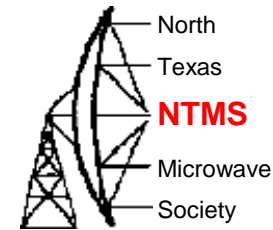
PIN attenuator



Pin closeup



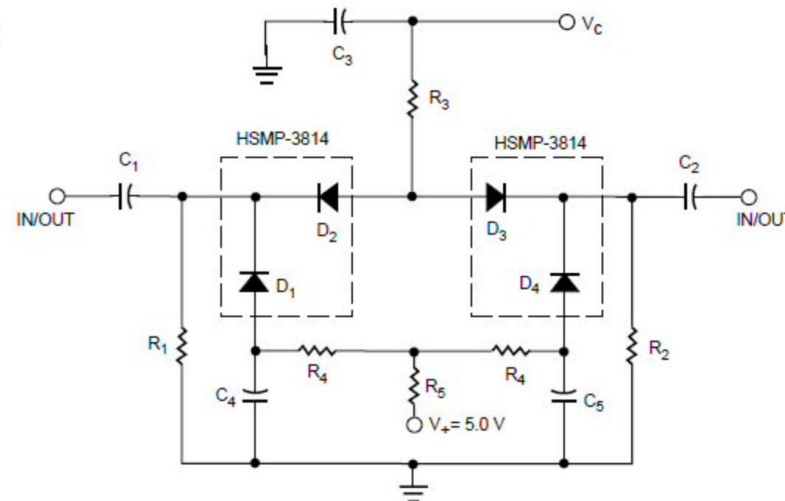
PIN examples



Voltage-variable attenuator using PIN diodes prior to Waugh



Ulrich
Rhode

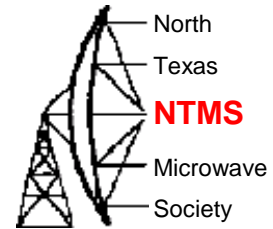


Waugh's attenuator



Ray
Waugh

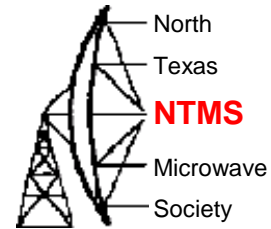
NTMS Group order



| Call | Name | Qty |
|--------|-----------------|-----|
| KM5PO | Jim McMasters | 2 |
| KI5EMN | Paul Sarver | 2 |
| W5LUA | Al Ward | 1 |
| AA5AM | Scott Armstrong | 1 |
| WA5JAT | Jim Hudson | 2 |
| AB5SS | John Maca | 1 |
| AA9IL | Mike Kana | 2 |
| AF4JF | Herb Ullmann | 2 |
| K4CSO | Charles Osborne | 2 |
| N7JA | Jim Allyn | 1 |
| K6ML | Mike Lavelle | 3 |
| | | 19 |

Order placed with JLCPCB for 20 boards

JLCPCB order



Most Efficient, Economic, Innovative PCB Solutions

Founded in 2006, JLCPCB has been at the forefront of the PCB industry. With over 15-year continuous innovation and improvement based on customers' need, we have been growing fast, and becoming a leading global PCB manufacturer, who provides the rapid production of high-reliability and cost-effective PCBs and creates the best customer experience in the industry.

800,000⁺

Customers

20,000⁺

Orders Daily

450,000m²

Factory Area

620,000m²

Production Capacity/Month

6 Million⁺

PCBs Produced/Year

170⁺

Countries Covered

3000⁺

Employees

15

Years Founded

>99.97%

On-time delivery

<0.23%

Quality Complaint Rate

1 Day

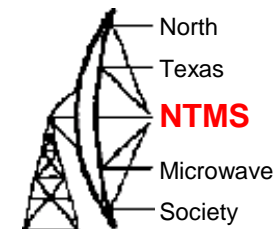
PCB Prototype

24/7

Online Service

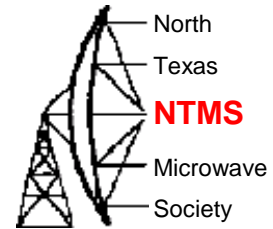
* As of January 2021

JLCPCB order

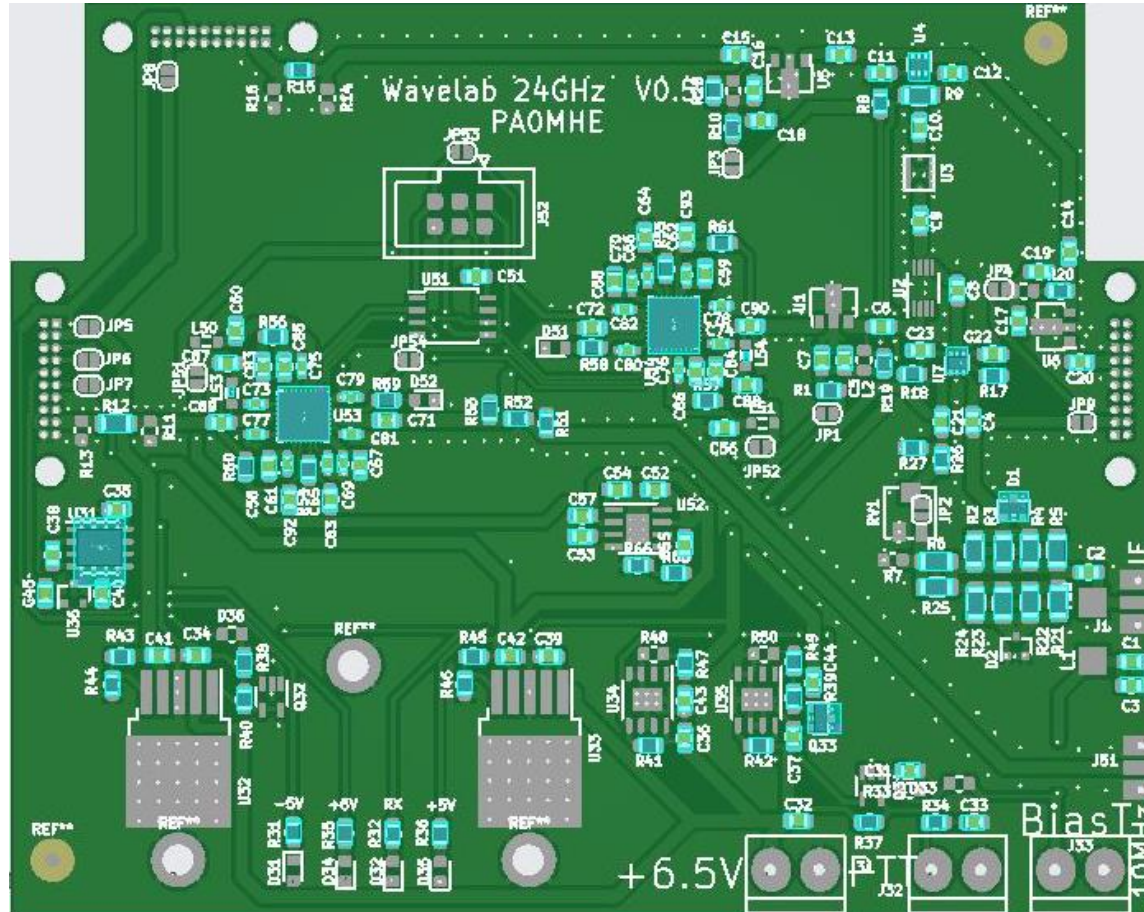


- Create an account on the website
- Upload the gerber, BOM, positions files
 - [Wavelab-24G-Addon-module/Kicad/V05 Kicad6/Wavelab24GHz_v05/production at main · PA0MHE/Wavelab-24G-Addon-module · GitHub](#)
- Review component placement and jlcpcb inventory shortages
 - Using search features you may find replacement parts
- Place the order

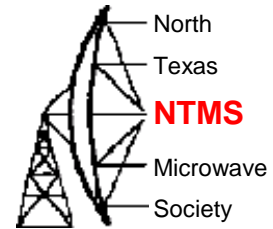
JLCPCB order



Confirming parts placement via website image



JLCPCB order





- Initial cost of PCBs was about a buck each.

J@LC JLCPCB Why JLCPCB? Capabilities Support Resources Order nov

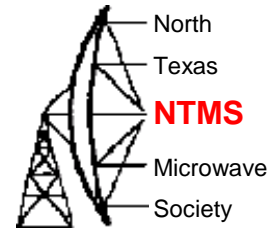
Home / Order History

Order History File Manager Parts Manager Payments Account Settings Messages ¹






Order Type Date Order #, Gerber file name...

| Product Detail | Product File | Price | Order Status |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| 2022-11-14 W202211140658438 | | | |
|  <p>PCB Prototype Order #: Y4-5139041A Build Time: 1-2 days 20 pcs \$20.80 Product Details</p> | <p>gerber_Y4 <input checked="" type="checkbox"/> Production Completed <input type="button" value="Quality Complaint"/></p> | <p>Merchandise Total: \$755.89 Shipping Charge: \$26.87 Order Total: \$782.76</p> | <p><input checked="" type="checkbox"/> Shipped DHL Express Worldwide <input type="button" value="Shipment Tracking"/></p> |
|  <p>Standard PCBA Order #: SMT0221113102520... Build Time: 2-3 days 20 pcs \$731.34 Product Details</p> | <p>wavelab 24 GHz BOM.xlsx positions.csv DFM Analysis <input checked="" type="checkbox"/> Production Completed <input type="button" value="Quality Complaint"/></p> | | |

JLCPCB order



- Shipment timeline. From payment to shipment < 6 days


| | | | | |
|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
|  Submitted 2022-11-14 06:58 |  Paid 2022-11-14 19:17 |  Reviewed 2022-11-14 19:17 |  In Production 2022-11-15 12:05 |  Shipped 2022-11-20 13:13 |
|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|

Shipped

Tracking #: [1248274300](#)

DHL Express Worldwide

Photos of package:



2022/11/23 10:43:00 Shipment has departed from a DHL facility CINCINNATI HUB - USA,CINCINNATI HUB, OH - USA

2022/11/23 07:14:00 Clearance processing complete at CINCINNATI HUB - USA,CINCINNATI HUB, OH - USA

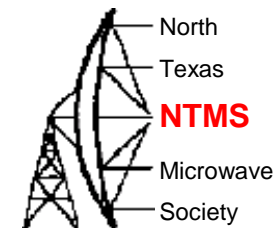
2022/11/23 06:31:00 Processed at CINCINNATI HUB - USA,CINCINNATI HUB, OH - USA

2022/11/23 05:21:00 Arrived at DHL Sort Facility CINCINNATI HUB - USA,CINCINNATI HUB, OH - USA

2022/11/22 21:40:00 Customs clearance status updated. Note - The Customs clearance process may start while the shipment is in transit to the destination.,CINCINNATI HUB, OH - USA

2022/11/22 14:15:00 Shipment has departed from a DHL facility HONG KONG - HONG KONG SAR, CHINA,HONG KONG - HONG KONG SAR, CHINA

Add on board by PA0MHE



- Board provides:
 - +3.3v, +/- 5v, +6v power to add on board and module
 - LO / IF frequencies (programmable ATTINY for LO freqs)
 - Connections to pin attenuator
- Key components:
 - 2 x ADF4351 RF synthesizers and ATTINY
 - Mixer 1.5-4.5 GHz
 - 800 ma 3.3v regulator
 - 3 x DC-6 GHz 3.9 db NF, 21 db gain MMICs
- Support:
 - NTMS Group PCB order
 - Wavelab groupsio -<https://groups.io/g/Wavelab24GHz>

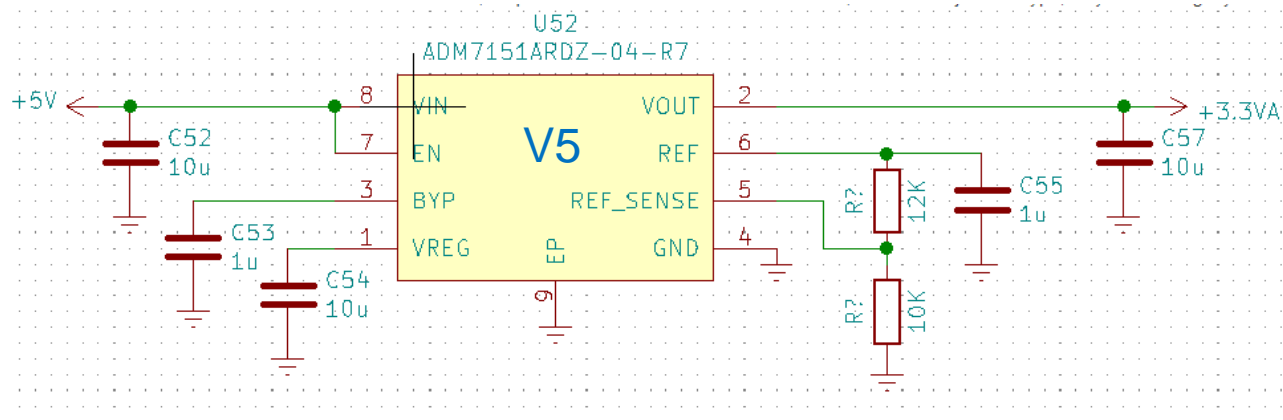
V5 changes from V4

R65, R66 added as option for U52 ADM7151 (chip shortage)

R36 update service print to "+5V"

U6 changed footprint to MGA-86576 (still possible to mount PGA103+, but too little gain)

J31, J32, J33, J1, J2, J3 No solder paste

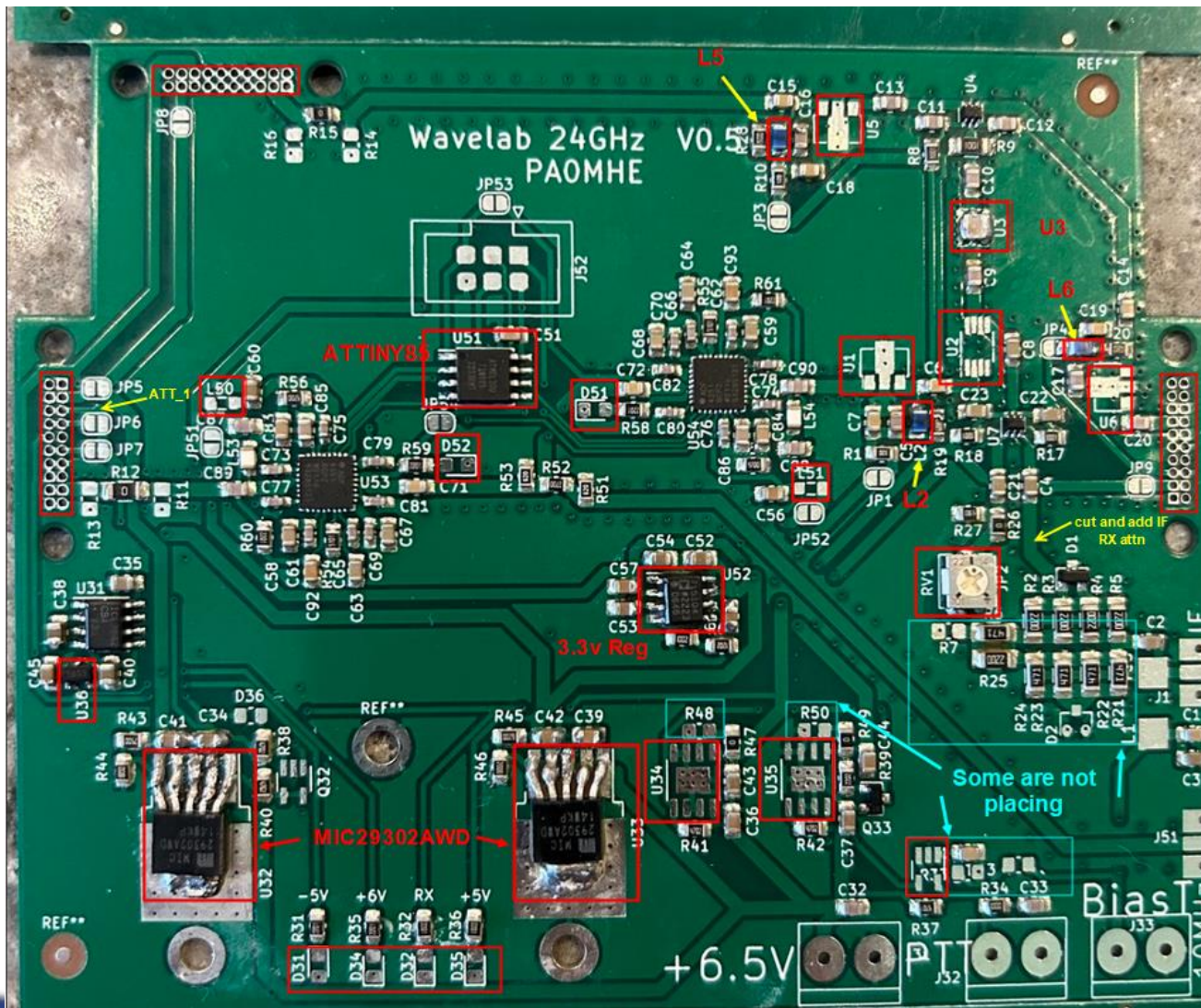
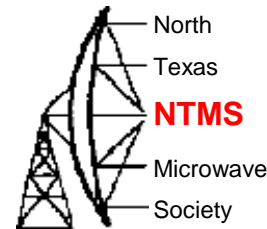


V4

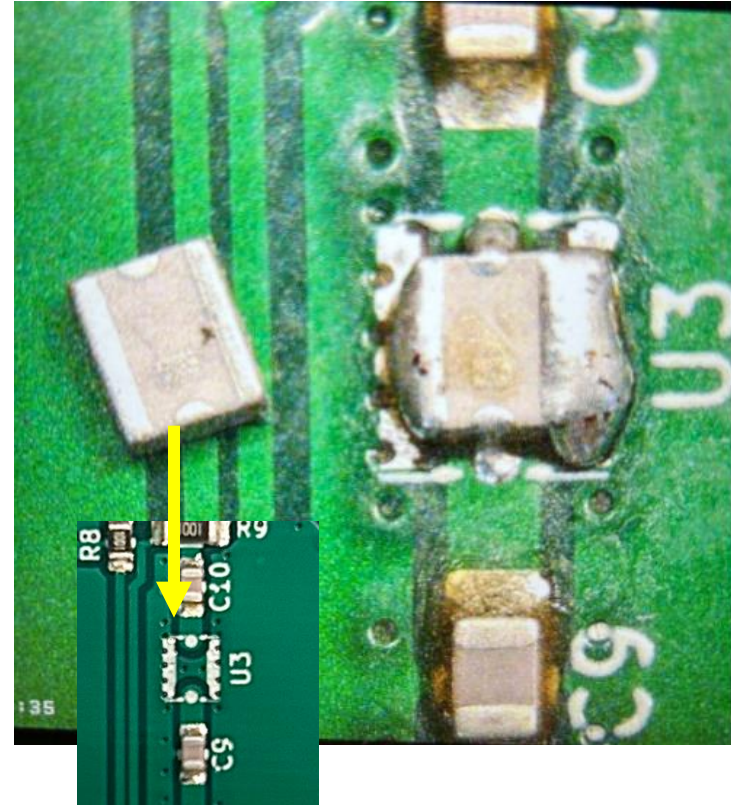
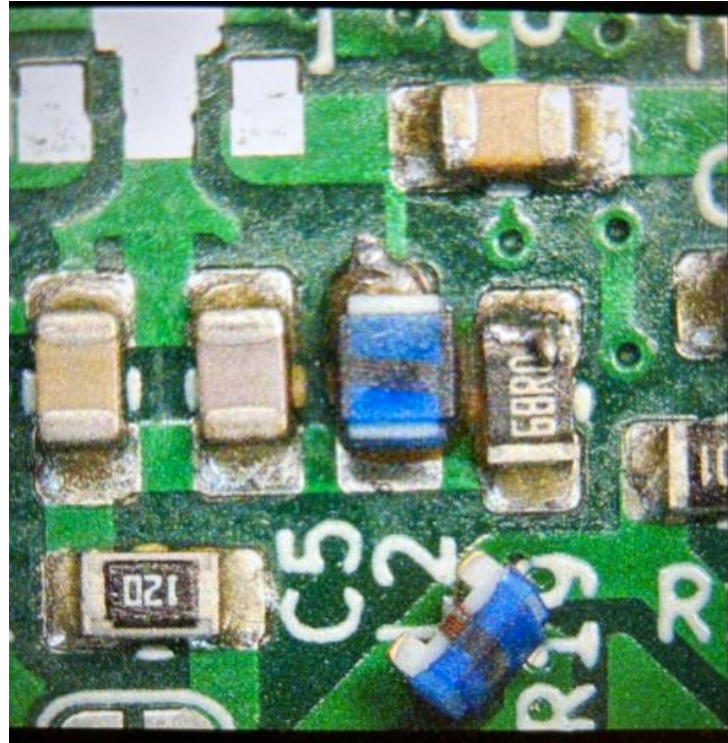


V5

Remaining parts

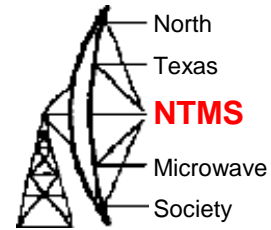


Soldering technique



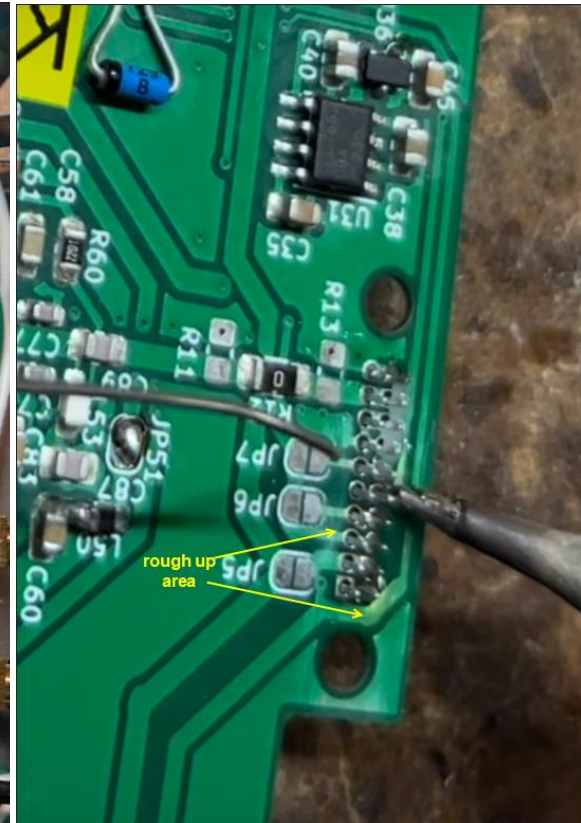
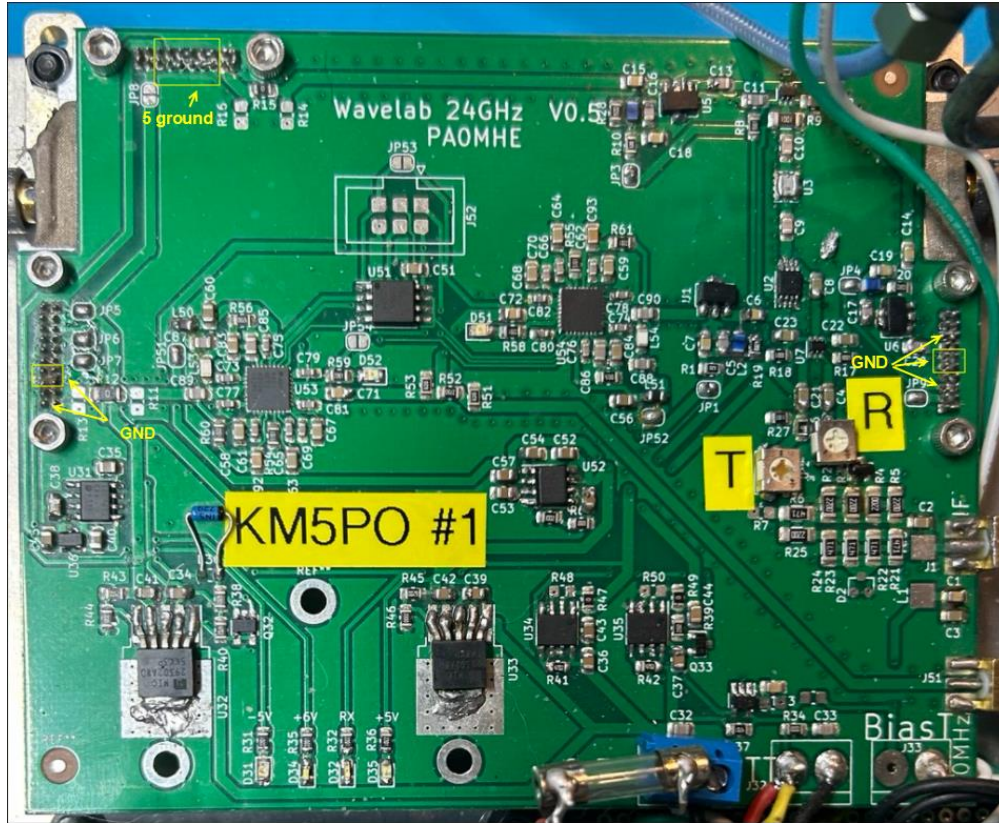
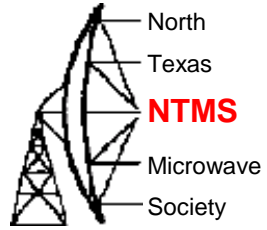
Small I/O footprint before placing

Soldering technique

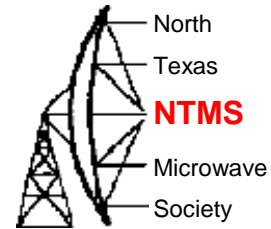


- Solder pin strip headers after DC checks are performed and validated
 - Rough up pin hole connections with light sandpaper
 - Tack one pin in place while insuring connector is aligned properly.
 - Start with J3/upper left -TX IF. 5 ground conns ganged together. 1 edge n/c and 1 edge ground.
 - Next is J4/right side - RX IF. 2 ground conns ganged. 2 other ground, 3 edge are n/c.
 - Last is J2/left side – LO. 2 ground conns ganged. 1 edge ground, other edge is MON but “n/c” on schematic.

Soldering technique

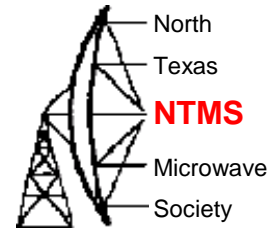


Inspect solder joints



- Ohm out parts from other connecting parts
 - Filter U3 is easy to short to ground.
 - Through filter resistance is slightly lower than filter in/out ports to ground.
 - L2, L5, L6 – do not overheat. Verify through coil resistance is ~ .27 ohm
 - I pre-tin the pads but do not leave a build up of solder on the pad
 - The mixer sanity checks:
 - *IF port ~ 340 ohms to ground*
 - *RF port 10-14 ohms to ground*
 - *LO port 8-9 ohms to ground*

Building tips

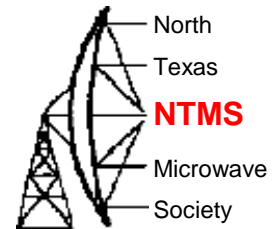


- Use a checklist of parts placement
 - For the NTMS December 2022 PCB order, a checklist is available here:
 - [Parts detail v5.pdf \(ntms.org\)](https://www.ntms.org/parts-detail-v5.pdf)

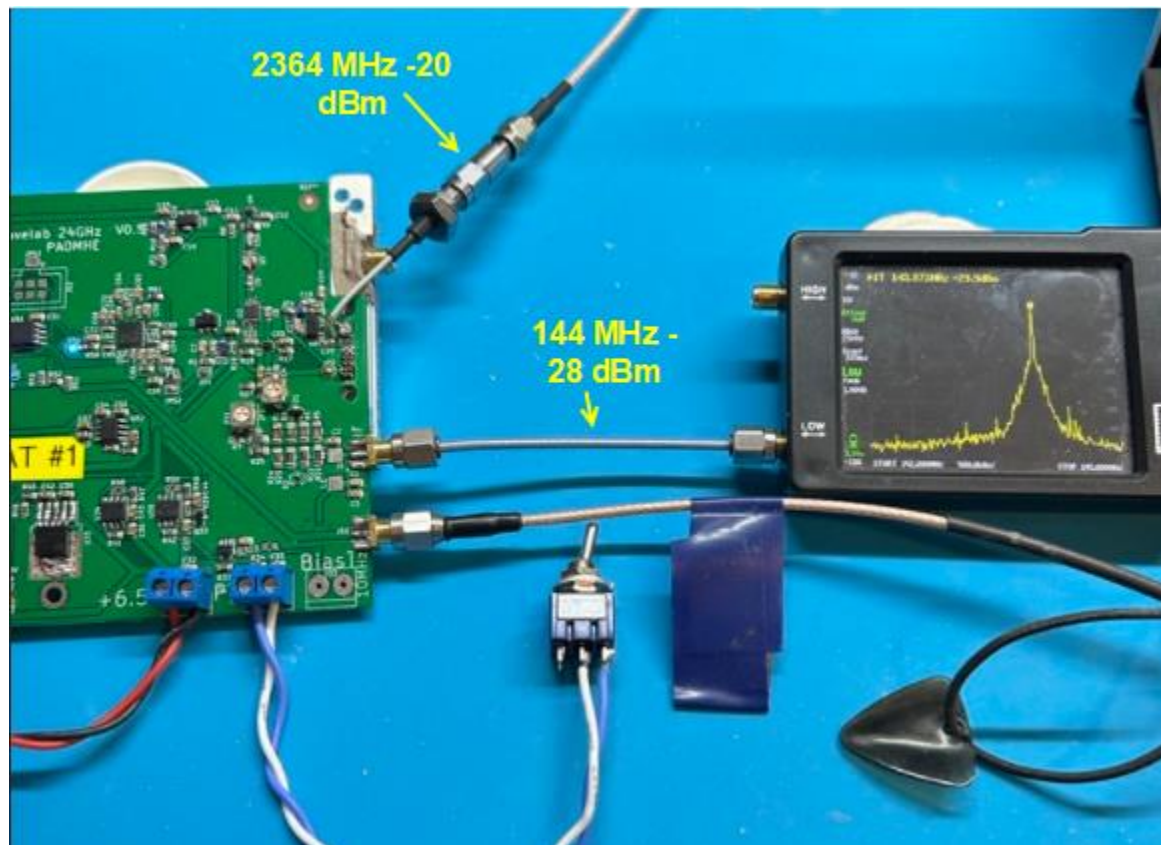
WASJAT #1

| Required Parts for December 2022 JLCPCB boards | | | |
|------------------------------------------------|------------------------------|----------|------------------------------------|
| Placed | Top to bottom, right to left | | |
| ✓ | 1 L5 | near JP3 | Do not overheat. Cont chk= .27 ohm |
| ✓ | 2 U5 | | |
| ✓ | 3 U3 | | |
| ✓ | 4 L50 | | |
| ✓ | 5 ATTINY85 | | |
| ✓ | 6 D52 LED blue | | |
| ✓ | 7 D51 LED blue | | |
| ✓ | 8 L51 near JPS2 | | |
| ✓ | 9 U1 | | |
| ✓ | 10 U2 | | |
| ✓ | 11 L2 | near JP1 | Do not overheat. Cont chk= .27 ohm |
| ✓ | 12 L6 | near JP4 | Do not overheat. Cont chk= .27 ohm |
| ✓ | 13 U6 | | |
| ✓ | 14 U36 | | |
| ✓ | 15 D36 zener leaded | | |
| ✓ | 16 U52 | | |
| ✓ | 17 RV1 | | |
| ✓ | 18 U32 | | High heat on ground tab |
| ✓ | 19 Q32 | | |
| ✓ | 20 U33 | | High heat on ground tab |
| ✓ | 21 U34 | | |
| ✓ | 22 U35 | | |
| ✓ | 23 Q31 | | |
| ✓ | 24 D31 LED orange | | ✓ replace drop resistor w/470 ohm |
| ✓ | 25 D34 LED white | | |
| ✓ | 26 D32 LED red | | |
| ✓ | 27 D35 LED green | | |
| ✓ | 28 3 header pins | | |
| ✓ | 29 SMA connectors | | |
| ✓ | 30 PTT connector | | |
| ✓ | 31 +6.5v connector | | |
| ✓ | 32 Fuse holder | | |

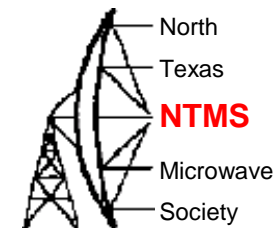
Building tips



- Use a checklist for initial checkout
 - https://ntms.org/files/Feb2023/Wavelab_power_up_testing.pdf

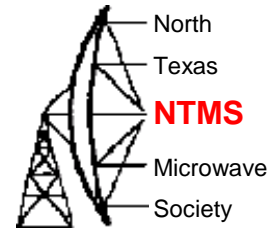


Building tips

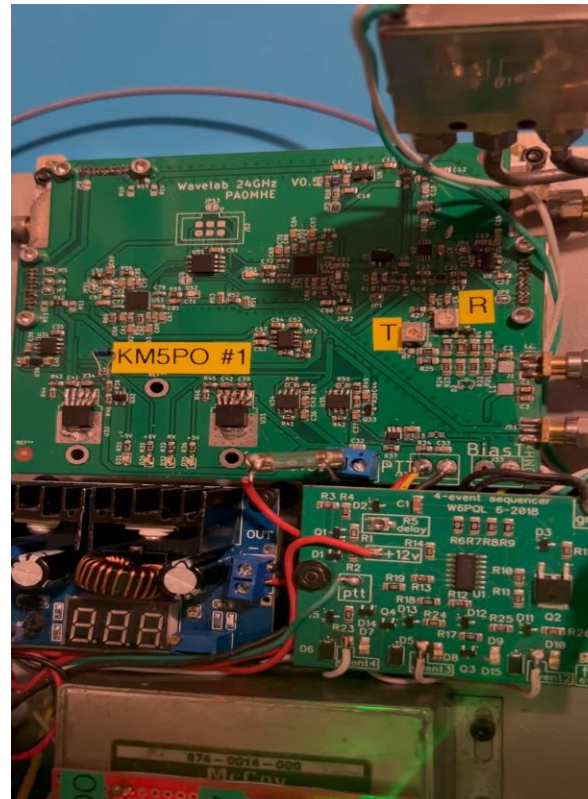


- DC power reversal
 - Hook up the input DC power backwards and expect to replace:
 - U31 – Charge pump voltage inverter
 - U34 – LDO voltage regulator
 - U35 – LDO voltage regulator
 - Many ways to prevent this but at minimum install a 3 A fast blow fuse on +6.5 V line.
- D31 LED (- 5 V sense) place Anode on ground pad!
 - Opposite of the other three voltage sense LEDs...
- Even though LO synth LED “lock” lights up, if you see a big signal ~ 750 Mhz at LO #1 output (*should be 1819 MHz*) then you do not have 10 MHz ref lock.
 - Correct behavior of LO lock LEDs at power on is 1819 MHz lights first (left side of board), then 2220 MHz one second later.
 - I used 15 dBm reference in the shop for initial testing of the PCB boards.
 - Final build used McCoy OCXO with 13 dBm output + 3 dB attenuator ahead of ref input.

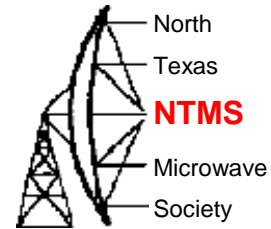
Building tips



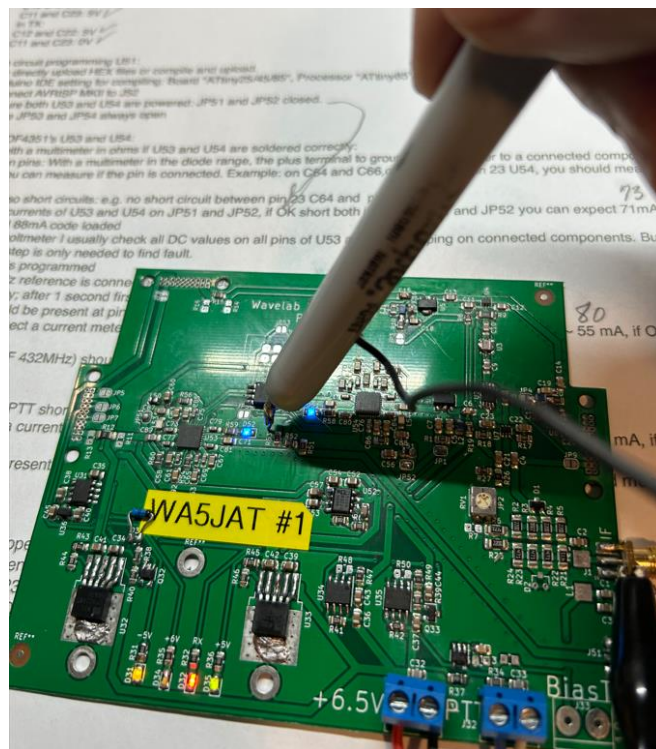
- Correct behavior of LO lock LEDs at power on is 1819 MHz lights first (left side of board), then 2220 MHz one second later.



Building tips

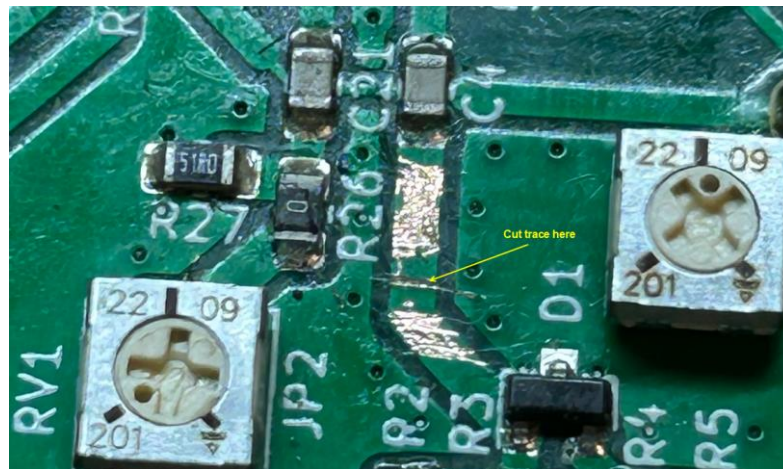


- Placing a probe between the LO LEDs will sample both LO frequencies

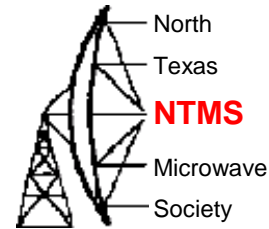


Building tips

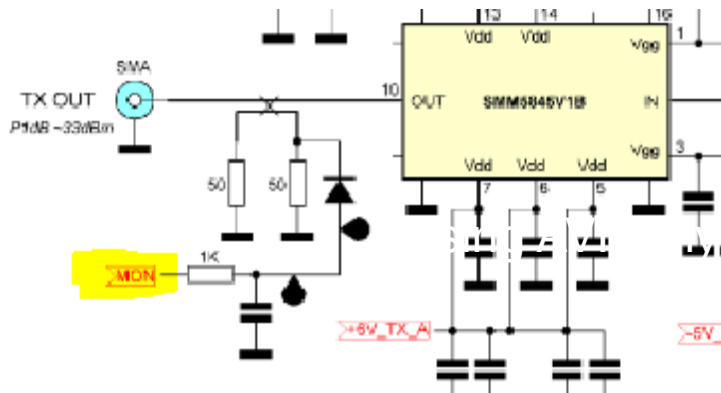
If you want to add receive side IF attenuation prepare the trace below C4



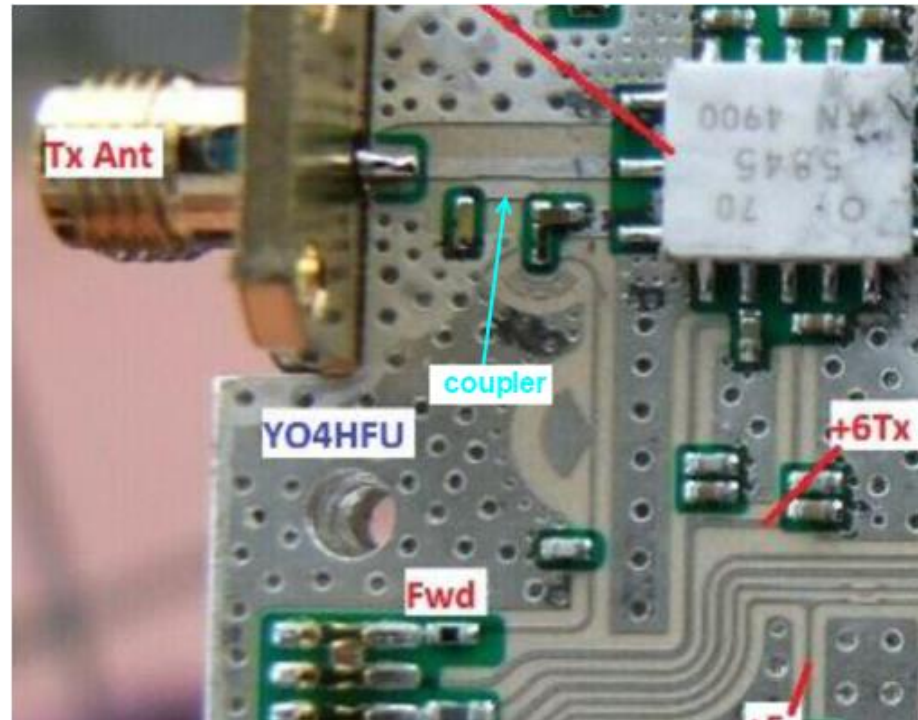
Monitor port



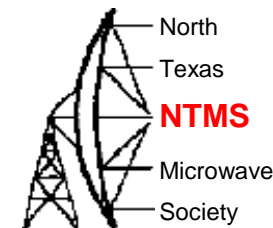
- Mon(itor) port



Measure varies from -.5 to -3.5v (J2 pin 1)

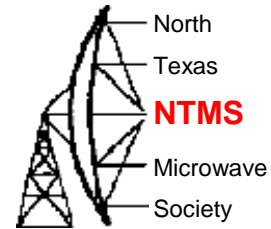


Program ATTINY



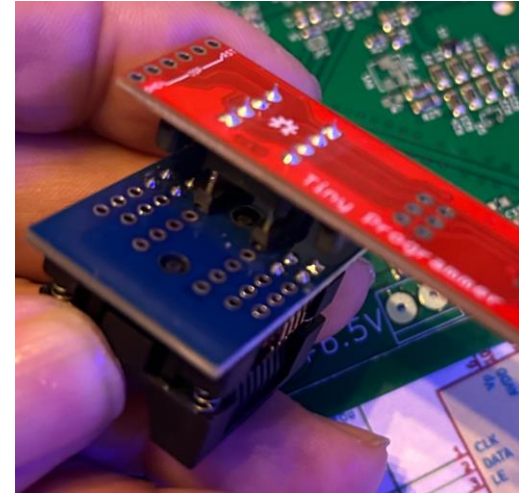
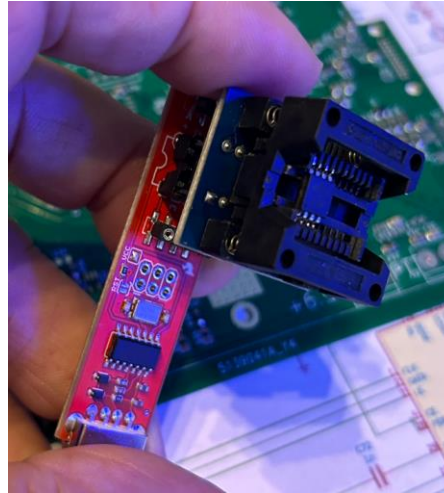
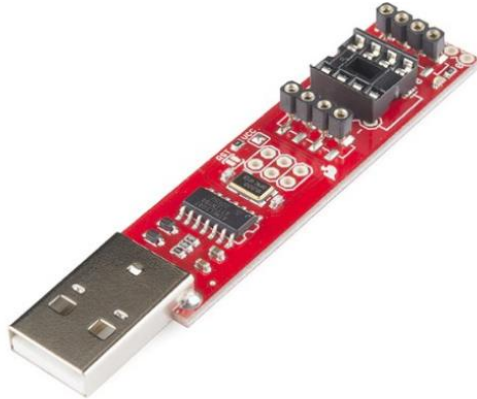
- Arduino sketch is on GitHub
 - [Wavelab-24G-Addon-module/ADF4351_fixed_tiny_24GHz.ino at main · PA0MHE/Wavelab-24G-Addon-module · GitHub](#)
 - Arduino integrated development environment needed (Free)
- Use Arduino IDE to burn bootloader to Uno and then upload Wavelab sketch to ATTINY
 - Uno required, breadboards, patch wiring
 - [Program an ATtiny With Arduino : 7 Steps \(with Pictures\) - Instructables](#)
- Use sparkfun “AVR tiny programmer” and SOIC chip holder, install drivers, upload Wavelab sketch directly to ATTINY
 - This will be explained in the following slides

Programming tools

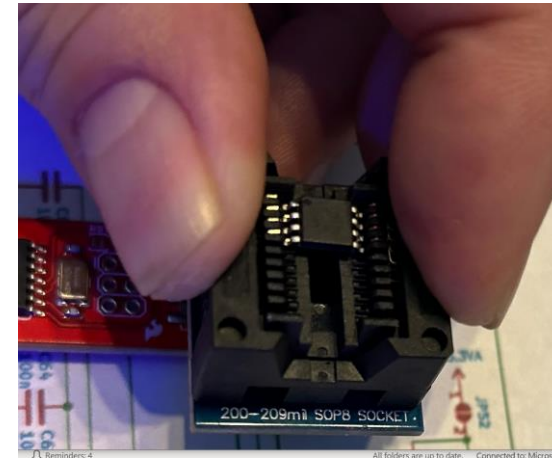


- Using AVR tiny programmer (windows)
 - Plug the programmer into your USB
 - If drivers are not found then download Zadig USBTiny drivers
 - Ref:<https://learn.sparkfun.com/tutorials/tiny-avr-programmer-hookup-guide/all>
 - Download the ATTINY addon to your Arduino IDE from GitHub
 - Configure IDE to use ATTINY85 (internal 1 MHz clock)
 - *Tools>Board>ATtiny85 (internal 1 MHz clock)*
 - Configure IDE to use ATTINY85 processor
 - *Tools>Processor>ATTINY85*
 - Configure IDE to use programmer USBtinyISP
 - *Tools>Programmer>USBtinyISP*
 - Plug in the ATTINY
 - Upload the code. (Use a blink sample sketch if you want to test 1st time)

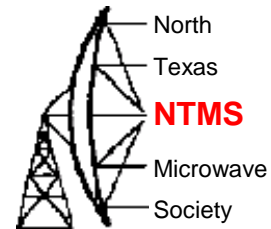
Programming tools



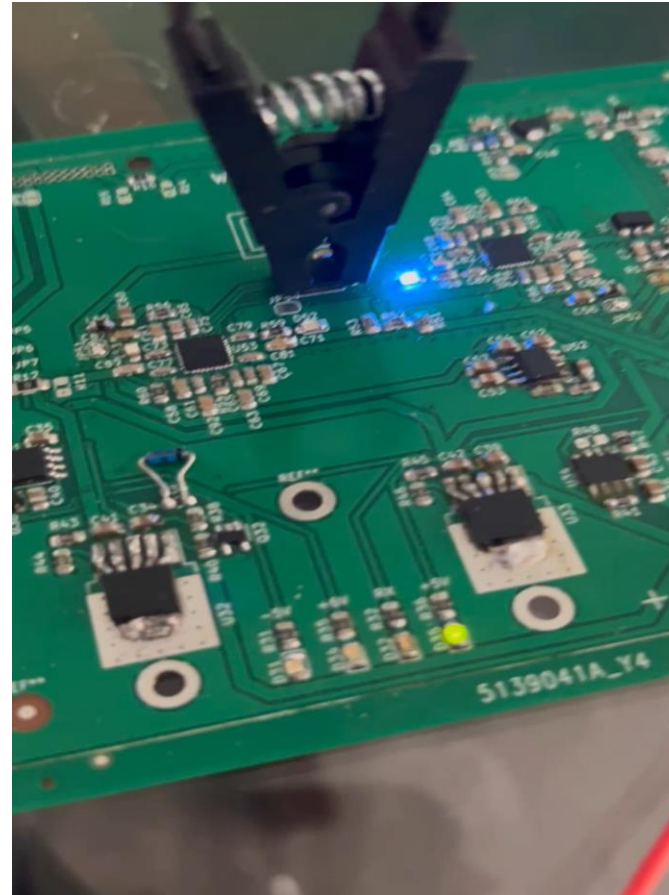
- On Amazon
 - AVR Tiny Programmer
 - SOIC8 SOP8 to DIP8 IC Programmer Socket Converter (verify the device will handle 200+ mil sizing)



In circuit programmer (clip)

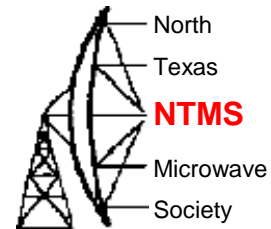


- I use the TinyProgrammer and plug in a cable with clip.
- Red wire in cable orients to pin 1 of the on-board chip to be programmed.



Video: +5v LED lights, #2 LO blinks, #1 LO blinks, then pause and #2 LO steady on.

LO frequencies



- The plan to put the module on USA terrestrial 24192 MHz

| | | | | |
|---------------------|----------|-----------|-----------|-------|
| Synthesizer 1 ADF 1 | 1819 MHz | x 12 mult | 21828 MHz | |
| Synthesizer 2 ADF 2 | 2220 MHz | | 2220 MHz | |
| | | | 24048 MHz | |
| | | | 144 MHz | IF |
| | | | 24192 MHz | Final |

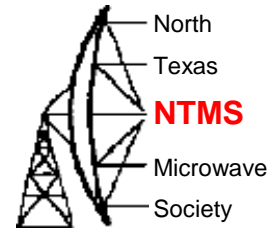
- For 144 MHz IF use the reg1 & reg2 lines below highlighted and comment out all others.

```

23 uint32_t reg1[6] = {0x5A0038, 0x8008051, 0x1A004E42, 0x4B3, 0x9A003C, 0x580005} ; // 1807MHz, ref 10MHz x2, 5dBm, Muxout: digital lock detect
24 + //uint32_t reg1[6] = {0x5A8048, 0x8008051, 0x1A004E42, 0x4B3, 0x9A003C, 0x580005} ; // 1819MHz, ref 10MHz x2, 5dBm, Muxout: digital lock detect
25 //uint32_t reg2[6] = {0x378000, 0x8008011, 0x1A004E42, 0x4B3, 0x8A003C, 0x580005} ; // 2m, 2220MHz, ref 10MHz x2, 5dBm, Muxout: digital lock detect
26 + //uint32_t reg2[6] = { 0x600018, 0x8008029, 0x1A004E42, 0x4B3, 0x9A003C, 0x580005 } ; //438MHz, 1926MHz, ref 10MHz x2, 5dBm, Muxout: digital lock detect
27 uint32_t reg2[6] = {0x608008, 0x8008029, 0x1A004E42, 0x4B3, 0x9A003C, 0x580005} ; // 70cm, 1932MHz, ref 10MHz x2, 5dBm, Muxout: digital lock detect

```

LO frequencies



- Pertinent register values are the first two hex strings

```

23 uint32_t reg1[6] = {0x5A0038, 0x8008051, 0x1A004E42, 0x4B3, 0x9A003C, 0x580005} ; // 1807MHz, ref 10MHz x2, 5dBm, Muxout: digital lock detect
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```

Reg 1 will control Integer and Fractional values

Enter hex number

 16

Binary number

 2

Reg 2 controls Phase adjust, prescaler (8/9), Modulus value

Enter hex number

 16

Binary number

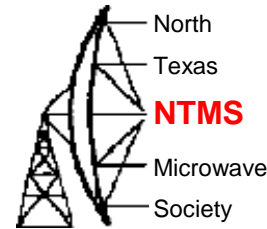
 2

ADF4351
Data Sheet

REGISTER MAPS

| INTEGER REGISTER 0 | | | | | | | | | | | | | | | | FRACTION | | | | | | | | | | | | | | | |
|---------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|--------------------------------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|--------------|-------|-------|-------|
| Dec: 181 | | | | | | | | | | | | | | | | Dec: 009 | | | | | | | | | | | | | | | |
| 0 1 0 1 1 0 1 0 1 0 0 0 0 0 0 0 0 0 1 0 0 1 | | | | | | | | | | | | | | | | 0 0 0 | | | | | | | | | | | | | | | |
| 16-BIT INTEGER VALUE (INT) | | | | | | | | | | | | | | | | 12-BIT FRACTIONAL VALUE (FRAC) | | | | | | | | | | | | CONTROL BITS | | | |
| RESERVED | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DB31 | DB30 | DB29 | DB28 | DB27 | DB26 | DB25 | DB24 | DB23 | DB22 | DB21 | DB20 | DB19 | DB18 | DB17 | DB16 | DB15 | DB14 | DB13 | DB12 | DB11 | DB10 | DB9 | DB8 | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 |
| 0 | N16 | N15 | N14 | N13 | N12 | N11 | N10 | N9 | N8 | N7 | N6 | N5 | N4 | N3 | N2 | N1 | F12 | F11 | F10 | F9 | F8 | F7 | F6 | F5 | F4 | F3 | F2 | F1 | C3(0) | C2(0) | C1(0) |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

LO frequencies



- There's an app for that!!

Analog Devices ADF435x Software

File Tools Help

Select Device and Connection Main Controls Registers Sweep and Hop Other Functions Features

RF Settings

Output **VCO**

RF Frequency: 1819 | 3638 MHz

Channel spacing: 1 | 2 kHz

Output divider: 2

Reference Frequency: 10 MHz

R counter: 1 Ref Doubler: Ref /2:

PFD Frequency: 20 MHz

Prescaler: 8/9

Feedback signal: Fundamental 3638 MHz

INT **FRAC** **PFD (MHz)** **Div** **RFout (MHz)**

$(\frac{181}{10} + \frac{9}{10}) \times 20 / 2 = 1819$

MOD **N = 181.9**

Phase adjust: 0. Off Phase Value: 1

Register 2

Low Noise/Spur Mode: Low noise mode LDP: 10 ns

Muxout: Digital Lock dete PD Polarity: Positive

Double buff: Disabled Powerdown: Disabled

Charge pump current: 2.50 CP 3-state: Disabled

LDF: FRAC-N Counter reset: Disabled

Register 3

Band Select Clock Mode: Low ABP: 6 ns (FRAC-N)

Charge Cancellation: Disabled CSR: Disabled

Clock Divider Value: 150

CLK Div Mode: Clock Divider Off

Register 4

VCO Powerdown: Disabled

MTLD: Disabled

Aux Output Select: Divided

Aux Output Enable: 0. Disabled

Aux Output Power: -4 dBm

RF Output Enable: 1. Enabled

RF Output Power: +5 dBm

Band Select Clock

Auto set Divider: 160

Freq (kHz): 125.000

Register 5

LD Pin Mode: Digital Lock Detect

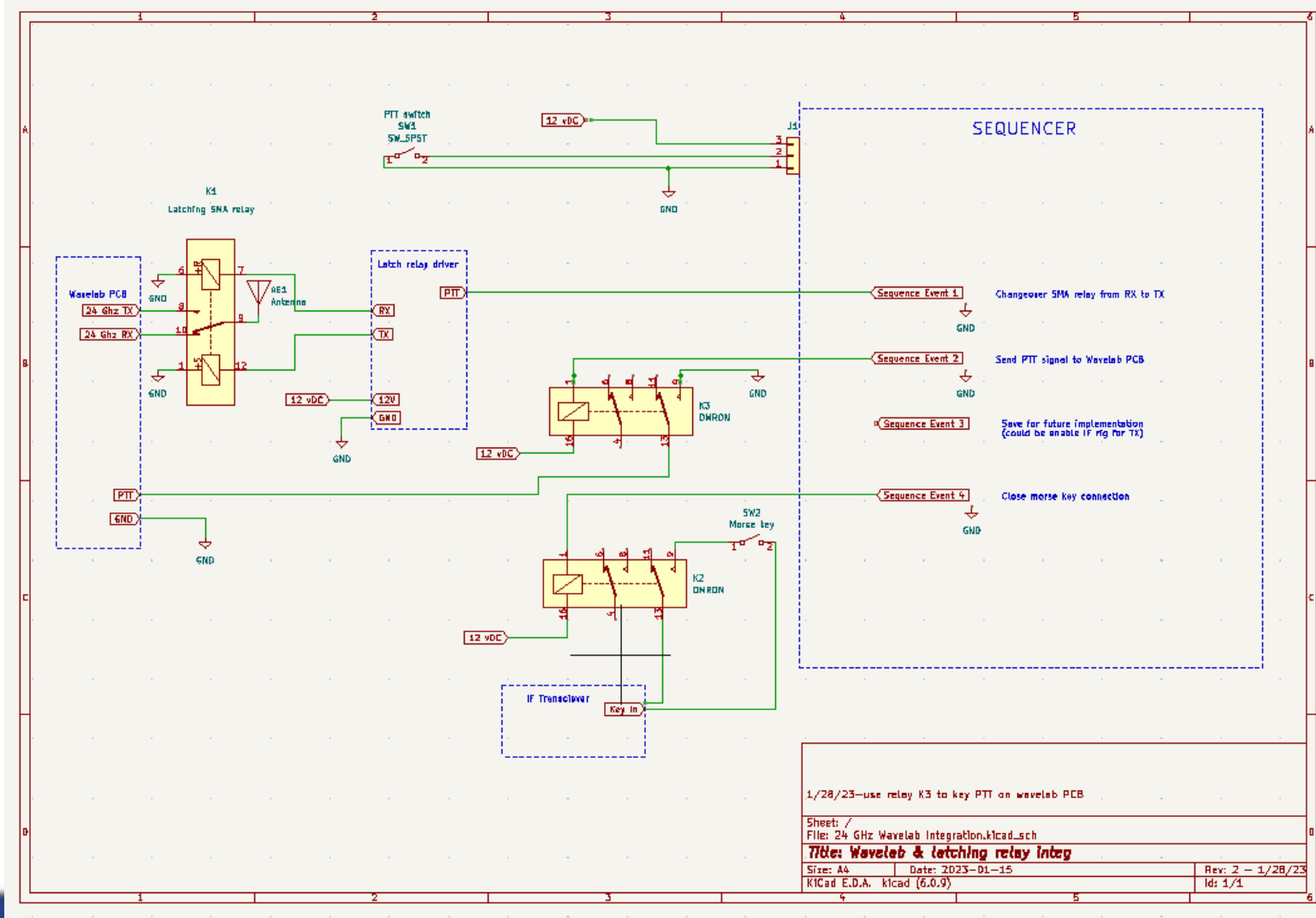
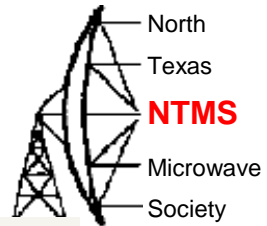
Registers

| | | | | | | |
|-----------|------------|-------------|----------|-----------|-----------|---------------------|
| 0x 5A8048 | 0x 8008051 | 0x 1A004E42 | 0x 4B3 | 0x 9A003C | 0x 580005 | Write All Registers |
| Write R0 | Write R1 | Write R2 | Write R3 | Write R4 | Write R5 | |

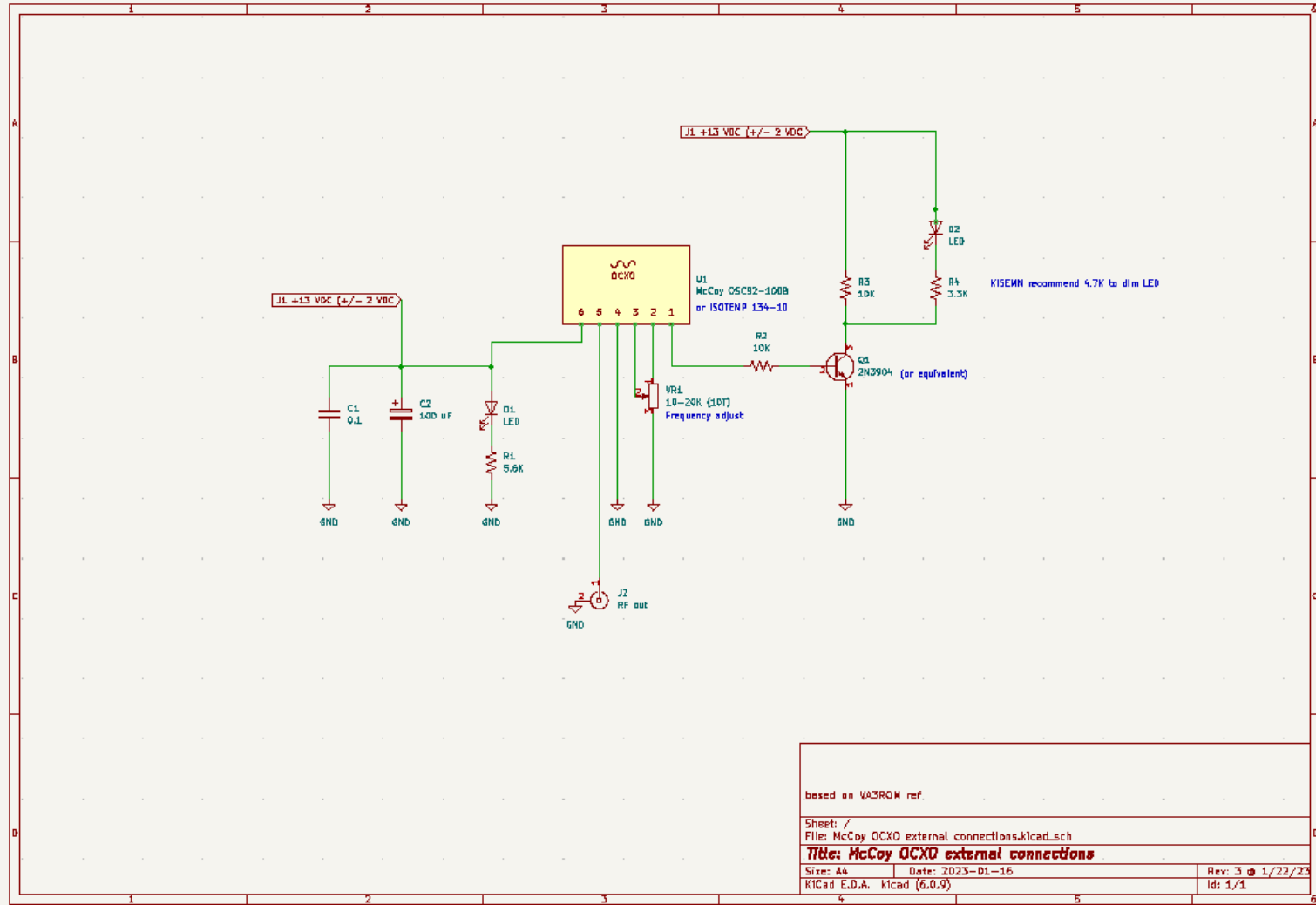
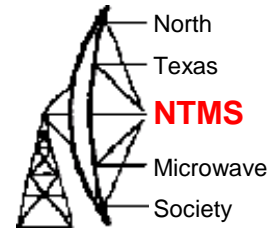
Application started.
 15:09:44: No USB adapter board attached. Try unplugging and re-plugging the USB cable.
 17:41:02: No USB adapter board attached. Try unplugging and re-plugging the USB cable.

Device in use: ADF4351 Software version: 4.5.1 **ANALOG DEVICES**

Integration



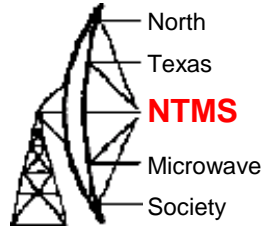
OCXO



High Hawk proving ground – Feb 3, 2023



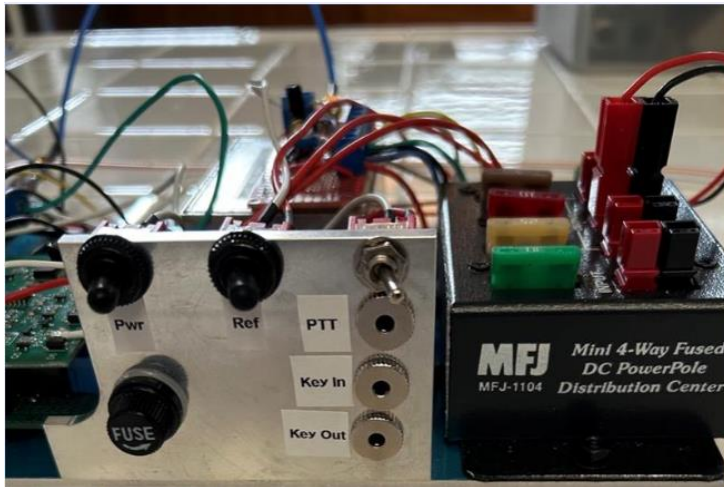
WA5JAT unit



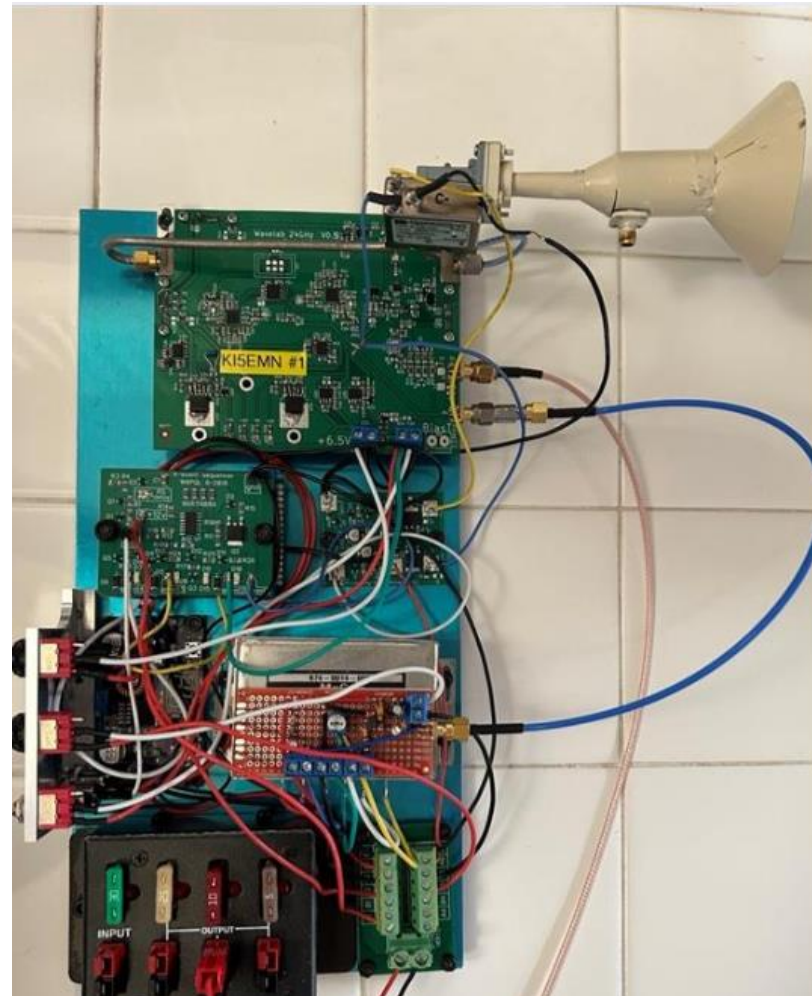
- Passes all tests and measured +32 dBm output



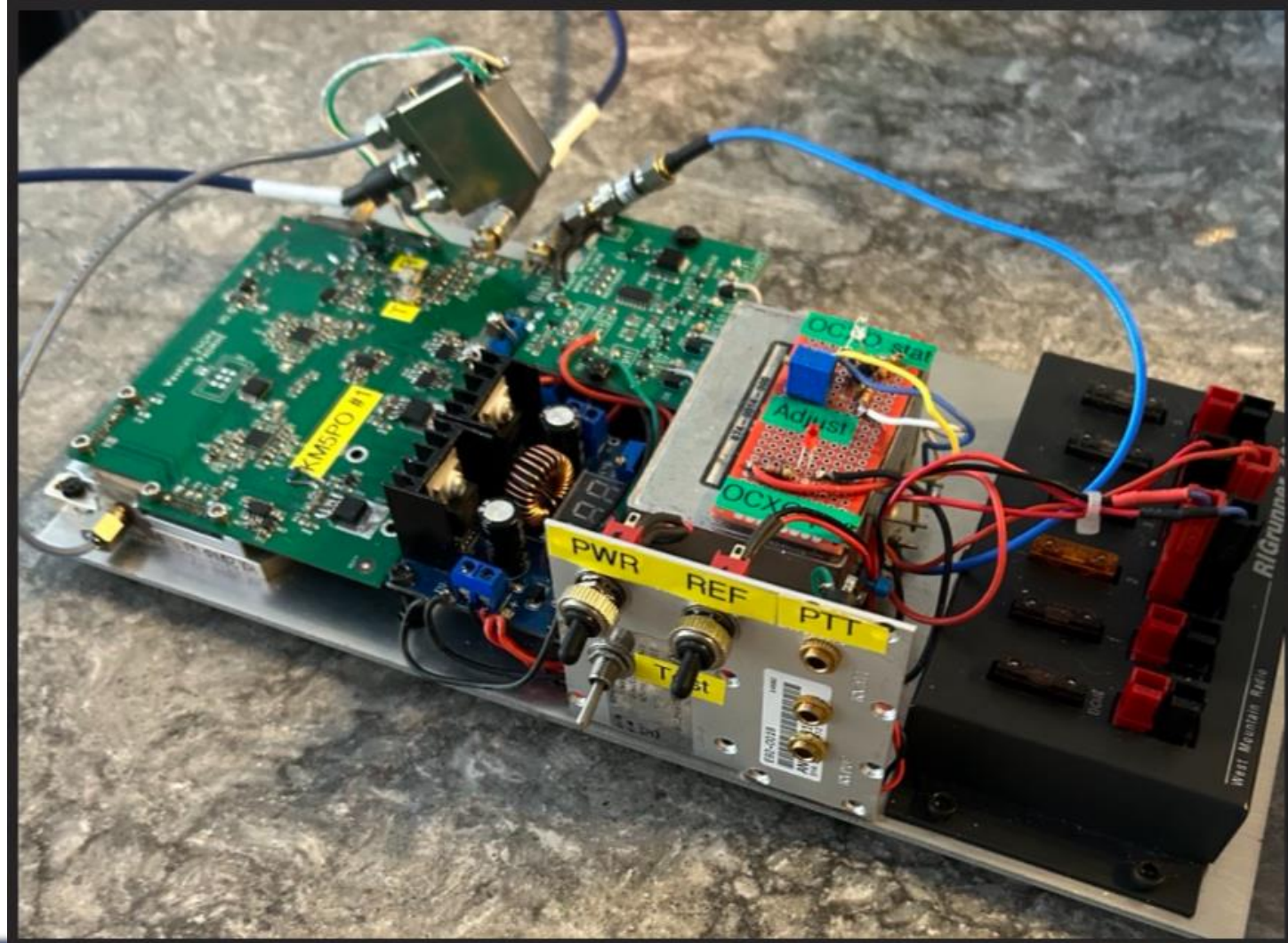
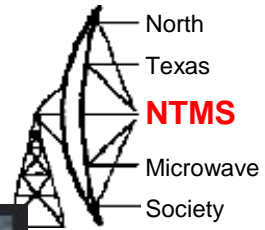
KI5EMN unit



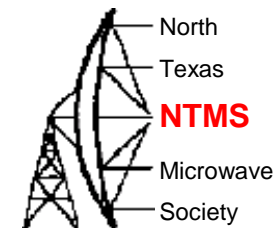
Uses latching relay driver with
SMA latching relay



KM5PO unit

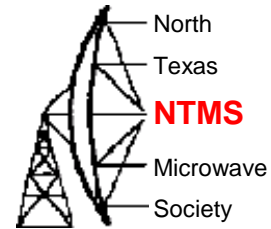


Next steps



- Obtain accurate measurements:
 - Spectral RF output
 - Power output
 - Receive sensitivity, noise figure
- Integrate improvements/optimizations.
- In field tests
 - KI5EMN integration of dish with his 10/24 feed horn
 - Extend DX success
- KM5PO Wavelab rig is available for rover use
 - User will need a horn or dish (I'm willing to help assemble)
- Collect final parts orders from NTMS Dec PCB owners

Resources



[Wavelab24GHz@groups.io | Home](https://groups.io/g/Wavelab24GHz)

[GitHub - PA0MHE/Wavelab-24G-Addon-module](https://github.com/PA0MHE/Wavelab-24G-Addon-module)

https://groups.io/g/Wavelab24GHz

Groups Your Groups Find or Create a Group

Home

Subscription

Messages

Hashtags

New Topic

Wavelab24GHz@groups.io

This group like to link all Ham radio amateurs who are building the Wavelab 24G Addon module from PA0MHE. Here we can pose questions, publish results, share improvements or modifications.

The design files are on the GitHub page: <https://github.com/PA0MHE/Wavelab-24G-Addon-module>

Group Information

<https://github.com/PA0MHE/Wavelab-24G-Addon-module>

69 Members

33 Topics · Last Post: Jan 8

Started on 06/02/22

Feed

Group Email Addresses

Post: Wavelab24GHz@groups.io

Subscribe: Wavelab24GHz+subscribe@groups.io

Unsubscribe: Wavelab24GHz+unsubscribe@groups.io

Group Owner: Wavelab24GHz+owner@groups.io

Help: Wavelab24GHz+help@groups.io

Group Settings

- 🔊 All members can post to the group.
- ✅ Posts to this group do not require approval
- ✅ Posts from new users require approval
- 📧 Messages are set to reply to group.
- 🔒 Subscriptions to this group do not require approval
- 📄 Archive is visible to anyone.
- 📖 Wiki is visible to members only.
- 🔒 Members cannot edit their messages.
- 🔒 Members can set their subscriptions to no.

https://github.com/PA0MHE/Wavelab-24G-Addon-module

Product Solutions Open Source Pricing

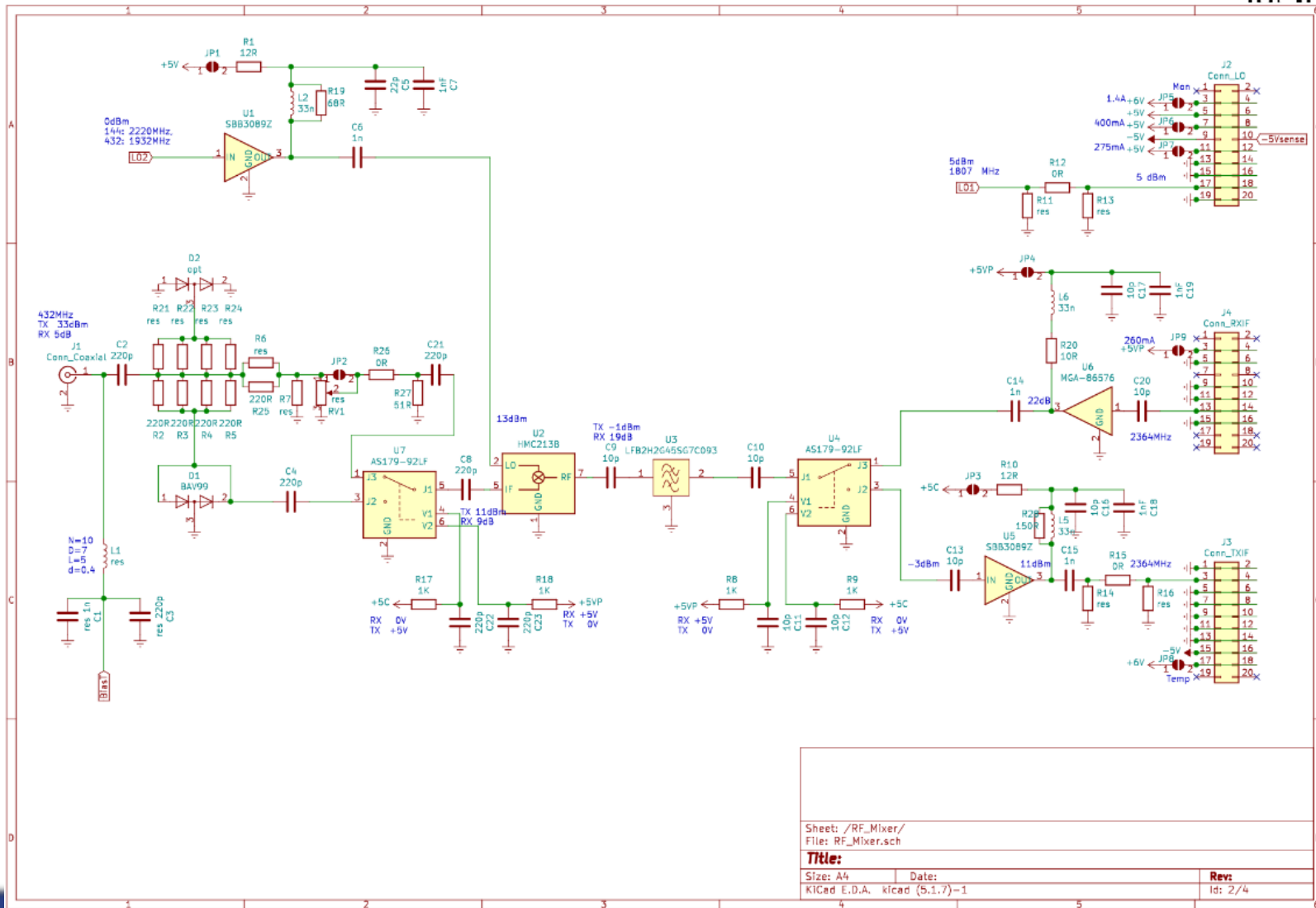
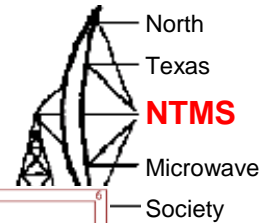
PA0MHE / [Wavelab-24G-Addon-module](#) Public

Code Issues Pull requests Actions Projects Security Insights

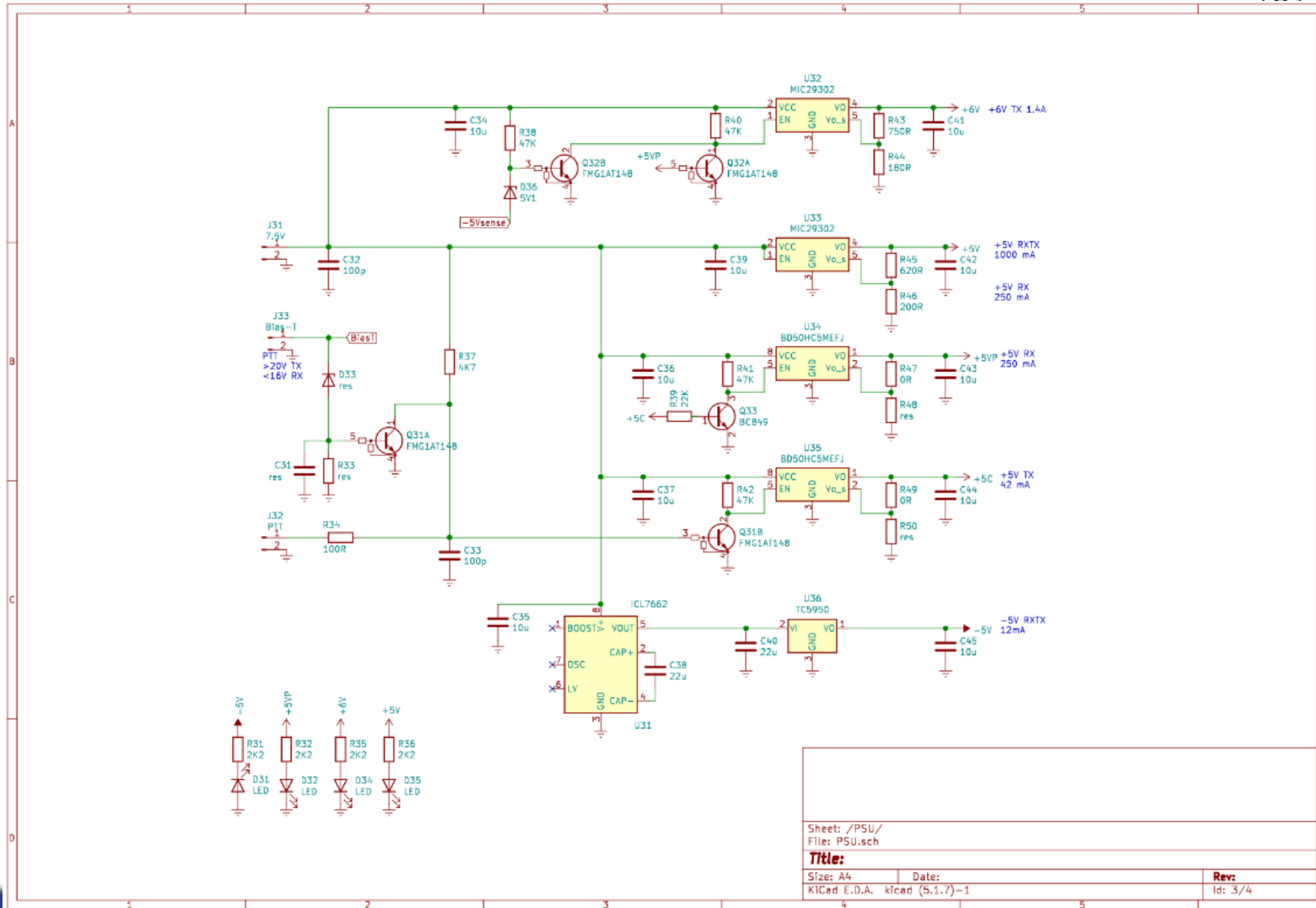
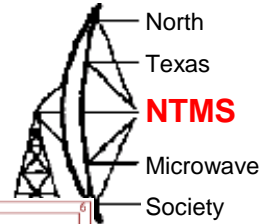
main 1 branch 0 tags [Go to file](#)

| | |
|------------------------------------|-------------------------------------|
| PA0MHE Deleted old V5 project file | ac64517 2 weeks ago |
| ADF4351_fixed_tiny_24GHz | Update ADF4351_fixed_tiny_24GHz.ino |
| HEX files | Added the HEX files |
| Kicad | Deleted old V5 project file |
| V5_documentation | V5 information |
| .gitattributes | Initial commit |
| BOM_v04_2.xlsx | Update BOM_v04_2.xlsx |
| ChangeList_V4.txt | Updated schematic |

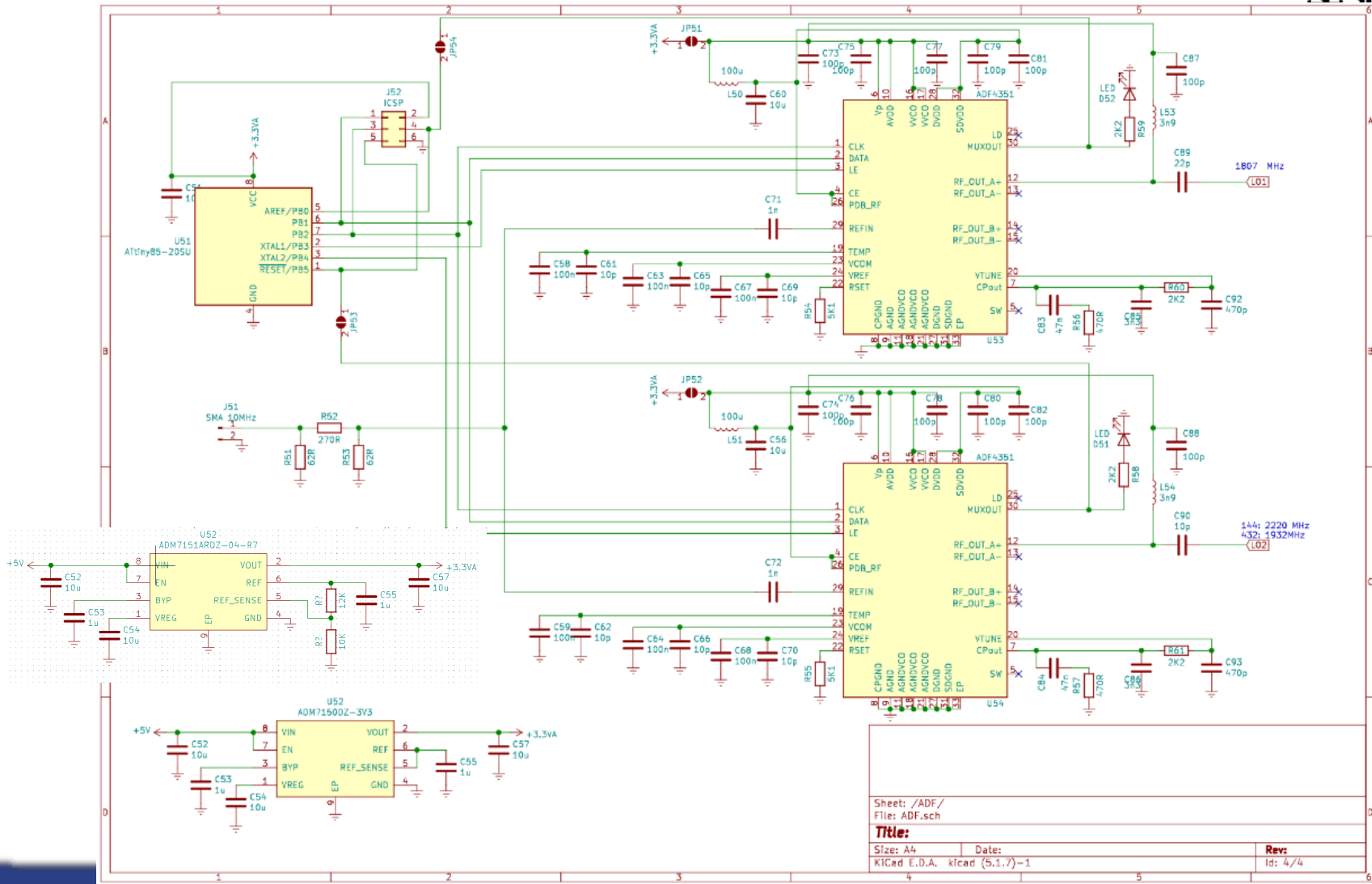
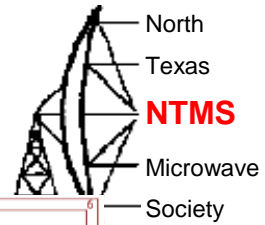
Add on board schematic pages



Add on board schematic pages



Add on board schematic pages



Questions?

