



# The Evolution of 1296 Power Amplifiers

Presentation to East Coast VHF Conference  
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# Background

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- Generating any sort of reasonable power at microwave frequencies has long been a challenge to amateurs.
- Up until recently most amplifiers were tubes—in fact the 2C39/7289 was the workhorse of both 1296 and 2304 for decades.
- Several operators built amplifiers using multiples of the 7289 to generate 500 watts or more.
- For many years I used one 7289 driving a pair( VE3CRU-- Hans(sk) ) had made many of the bare amplifier modules available in the 1980's driven by an SSB transverter.

# Key 7289 Characteristics

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- Needs about 1100 volts on the plate
- Low gain –roughly 8 db
- A pair can produce 150-180 watts although I never had more than 80-100 watts.
- They were cost effective in the 80's but SS devices making great strides currently.
- But—
  - they drift
  - Take a while to warm up(3 minutes or more)
  - Cooling is a challenge( many ops went water cooling)
  - Hard to find good tubes these days
- In 2013 after excellent success with LDMOS amplifiers from 50-432 MHz it was time to see if I could get something going at 1296 MHz.
- I put my tube amplifier “ out to pasture” and Stu VE2XX resurrected it and in fact greatly improved it .

# 7289 amplifier circa 1990/2015

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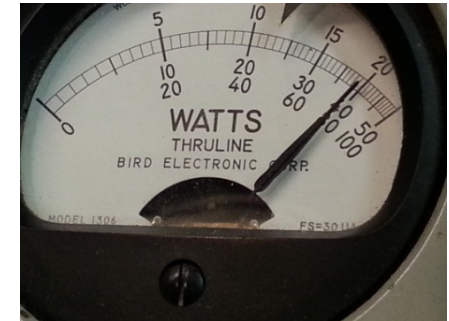
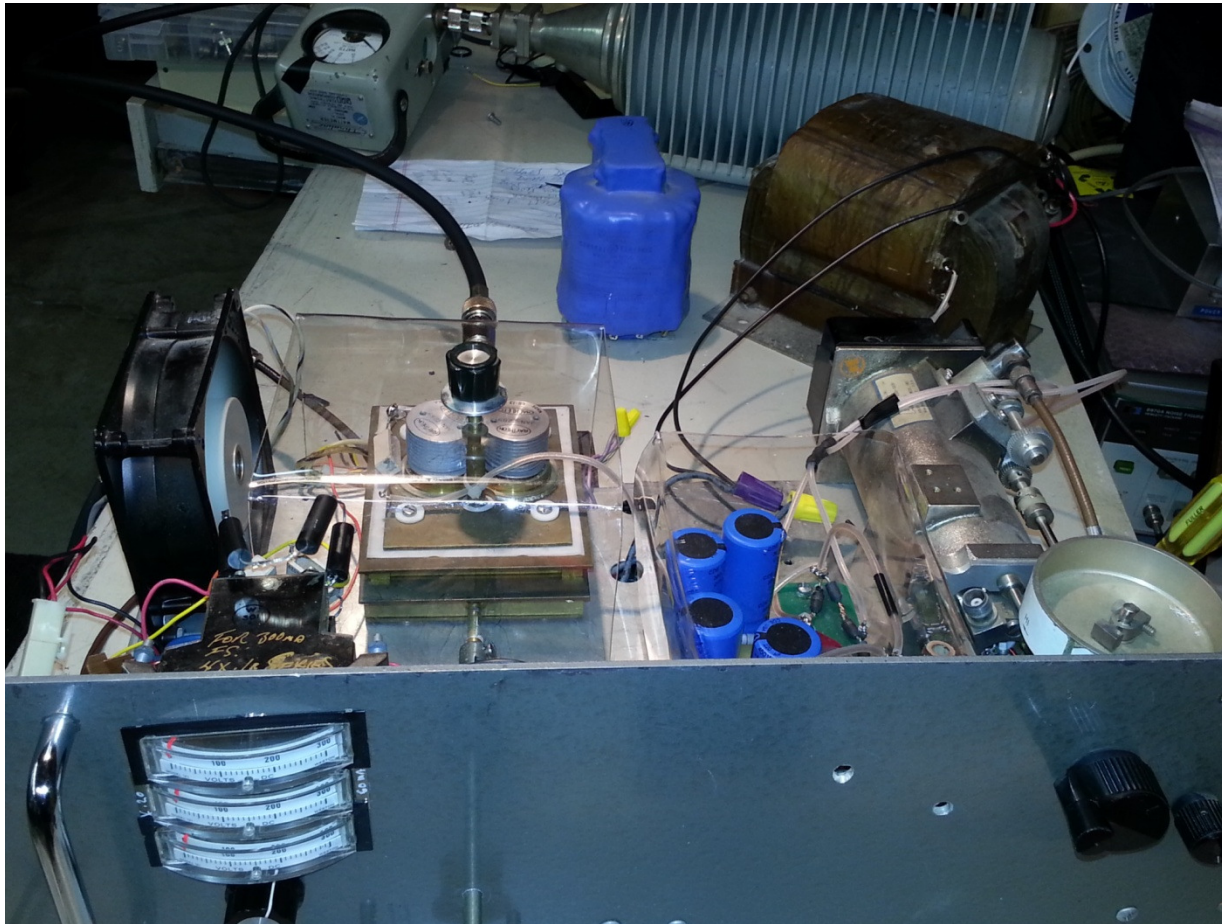


Photo Courtesy of VE2XX

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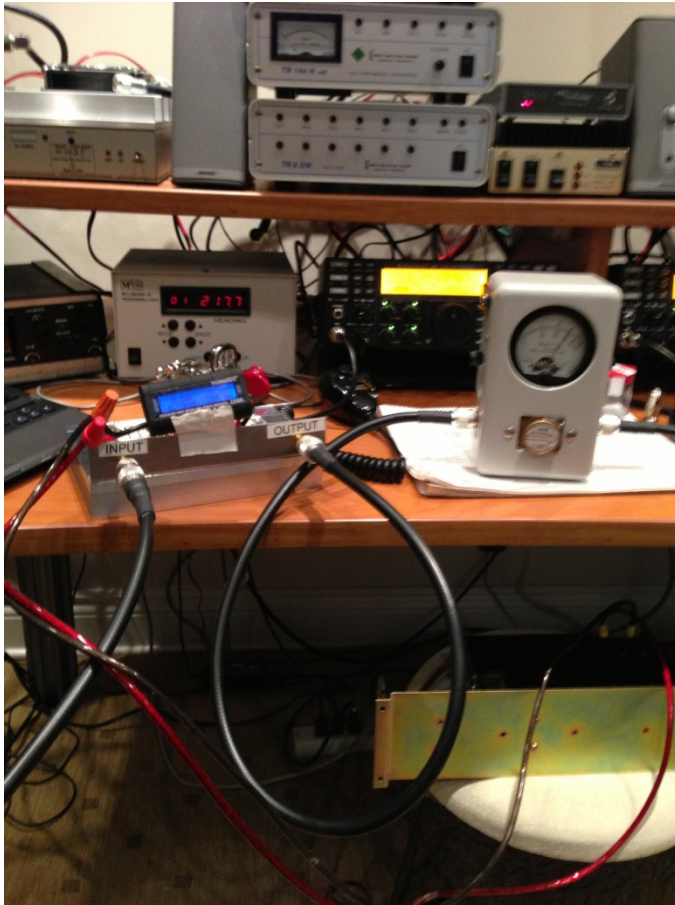
# The evolution to SS amps

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- Initially I tried MRF 286 amplifier with a pair of devices
  - W6PQL sells a range of options using the devices
  - [http://www.w6pql.com/xrf-286\\_amplifiers\\_for\\_23cm.htm](http://www.w6pql.com/xrf-286_amplifiers_for_23cm.htm)
  - A pair will do about 150 watts output ---
  - Devices are getting harder to find but are available from Spectran amplifiers
- LDMOS devices were just beginning to become available in 2013 when I started the project, but are now available from both NXP and Freescale.



## Initial Testing of W6PQL MRF286 ( pair) module in early 2013



- The initial testing was very positive—about 140 watts output with 8 watts drive
- 255 watts DC input at 27.75 volts
- Motivated me to want more power
- Note several modifications ( HB9BDD and VE4MA) to the design to improve performance and gain

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# 1296 MHz SSPA Design Objectives

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- I wanted “ Plug and Play”—no tuning or drifting.
- Simple Power Supply( I was ok for 28 or 50 volts)
- 500 watts output so east coast guys in W1 or W2 could hear me!!
- No buffer amplifiers to complicate switching—directly driven from Kuhne transverter( maximum 18 watts output).
- I settled on experimenting with PE1RKI modules.
  - MRF6S9160HR3 28 volt cellular devices 20db gain@ 1 GHz.
  - Each module is nominal 250 watts output at 3.5 watts drive
    - 4.5 watts input gives 300-330 watts output)
    - P1db is roughly 330 watts

# Single PE1RKI module

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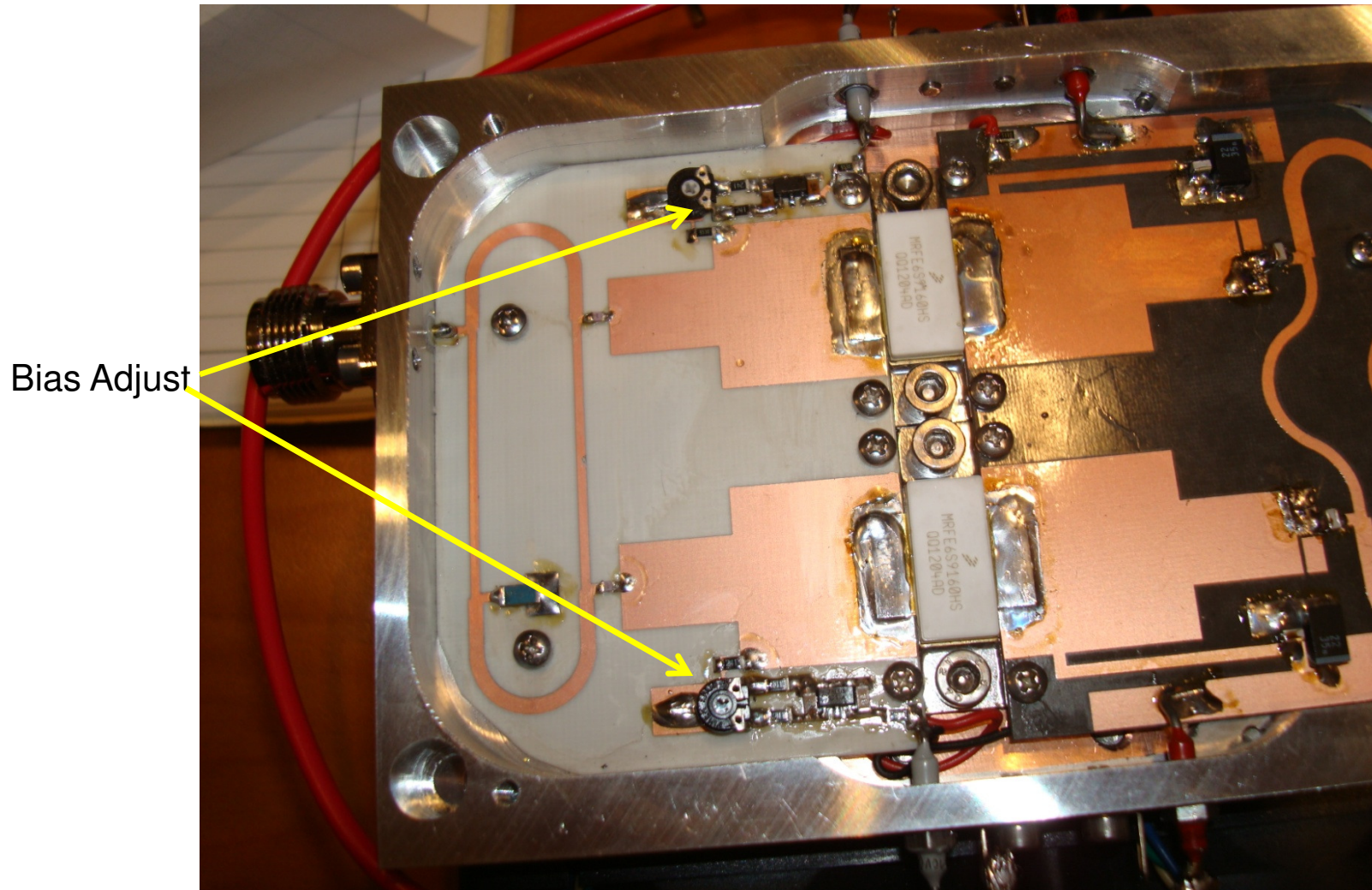


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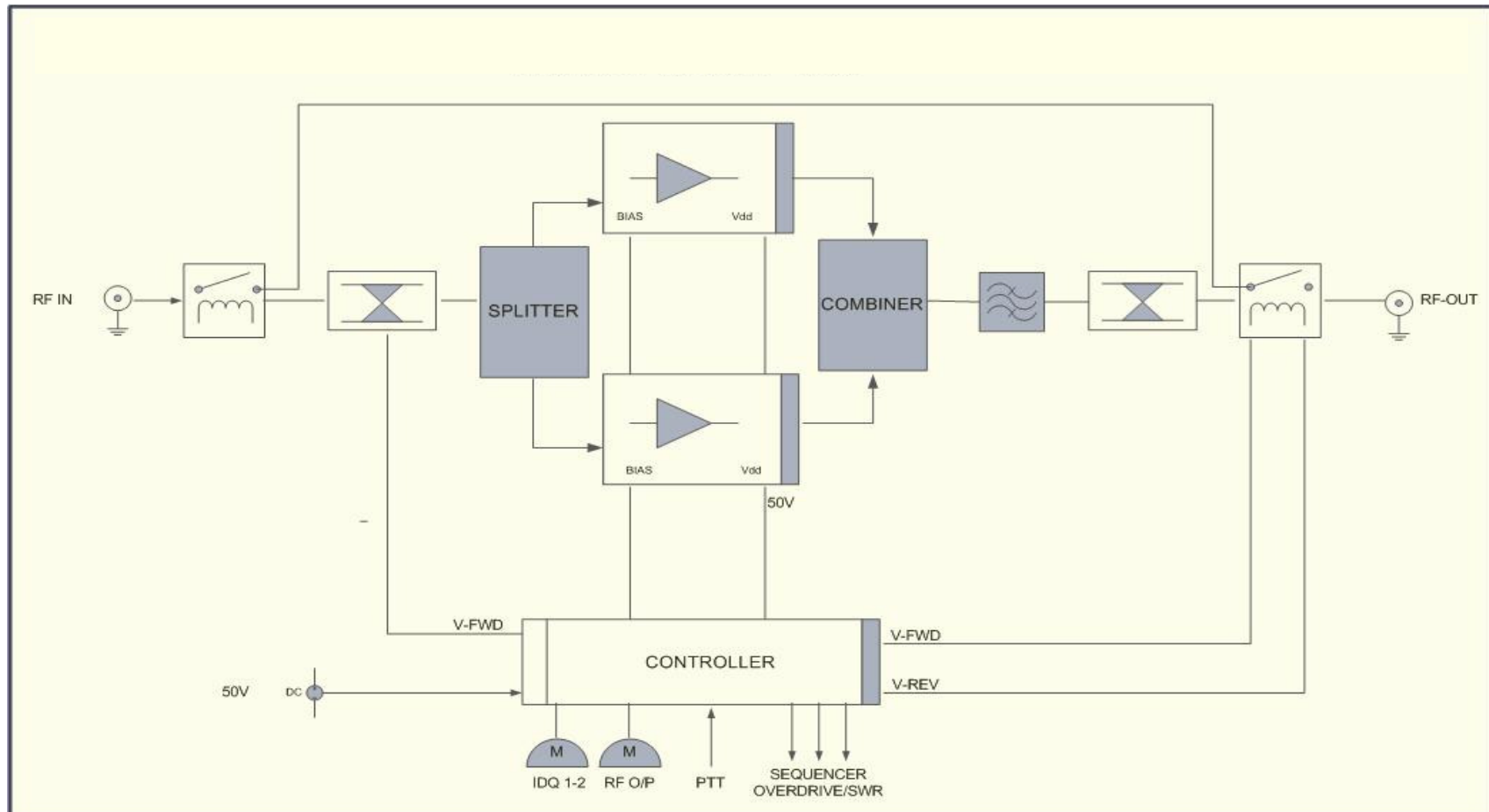


## 1296 Pallet with Motorola MRF 6S9160 devices

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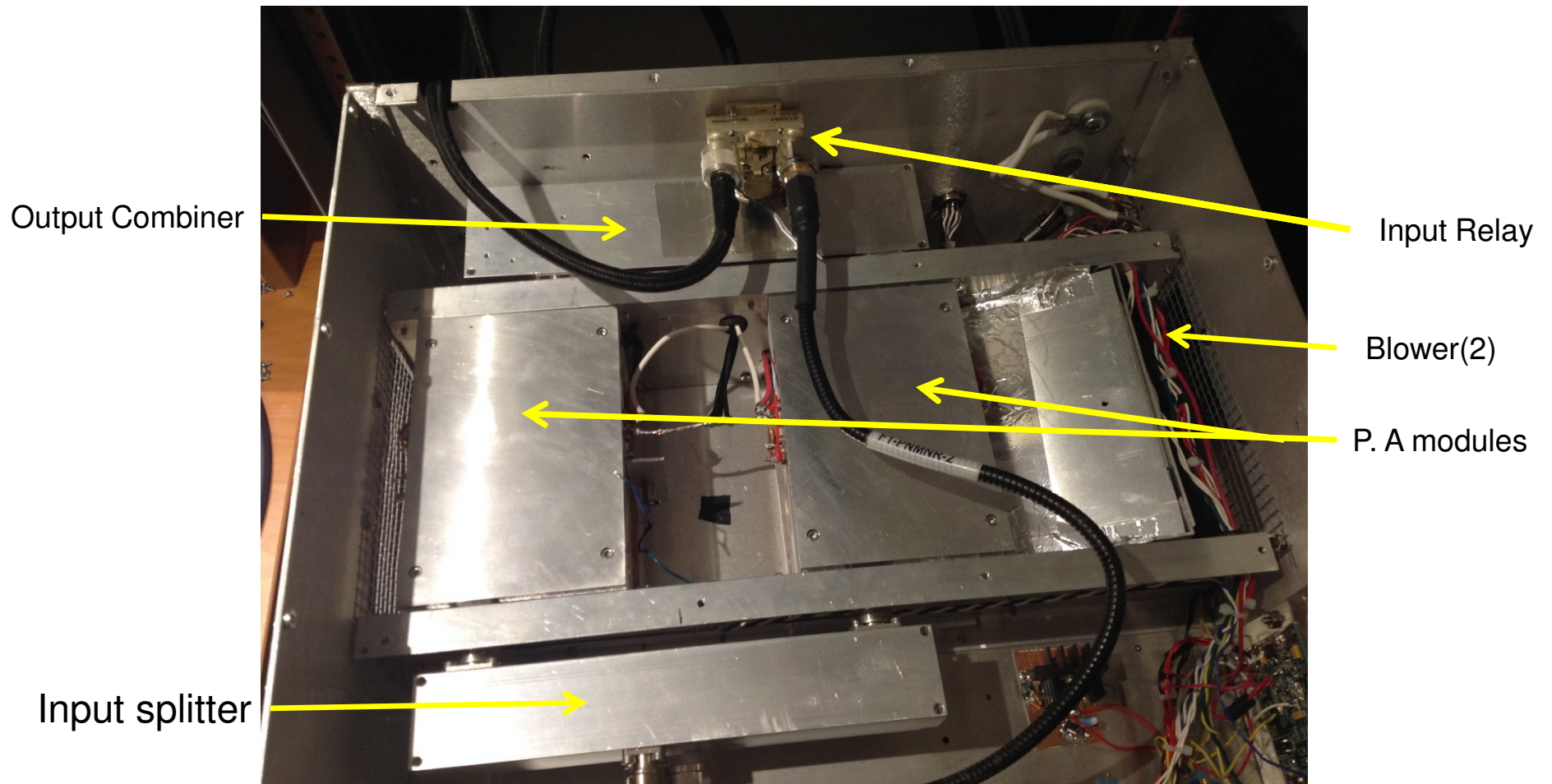


# Basic Layout of the amplifier



# Inside the 1296 SS amp( not much to see!)

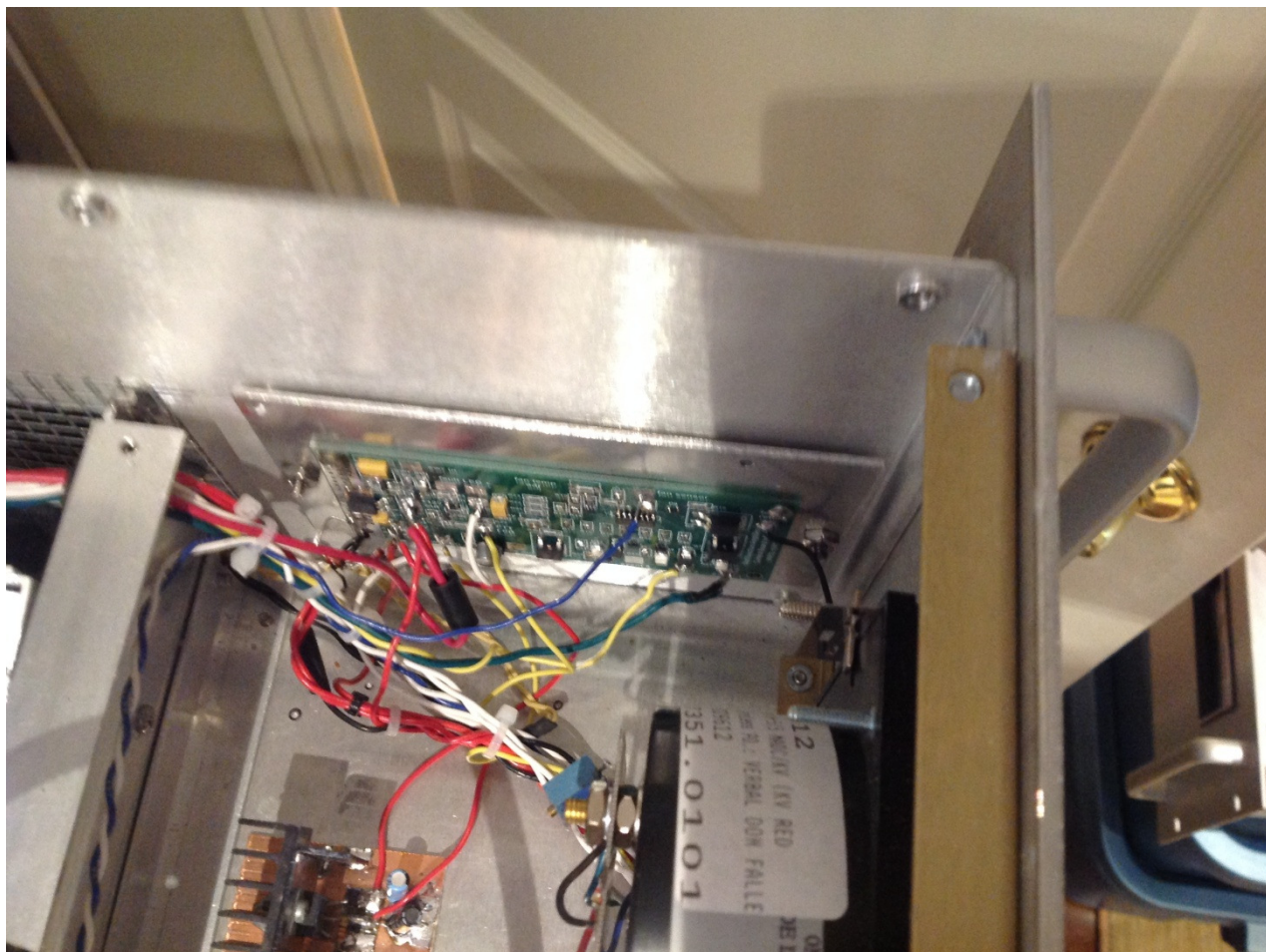
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# W6PQL control board

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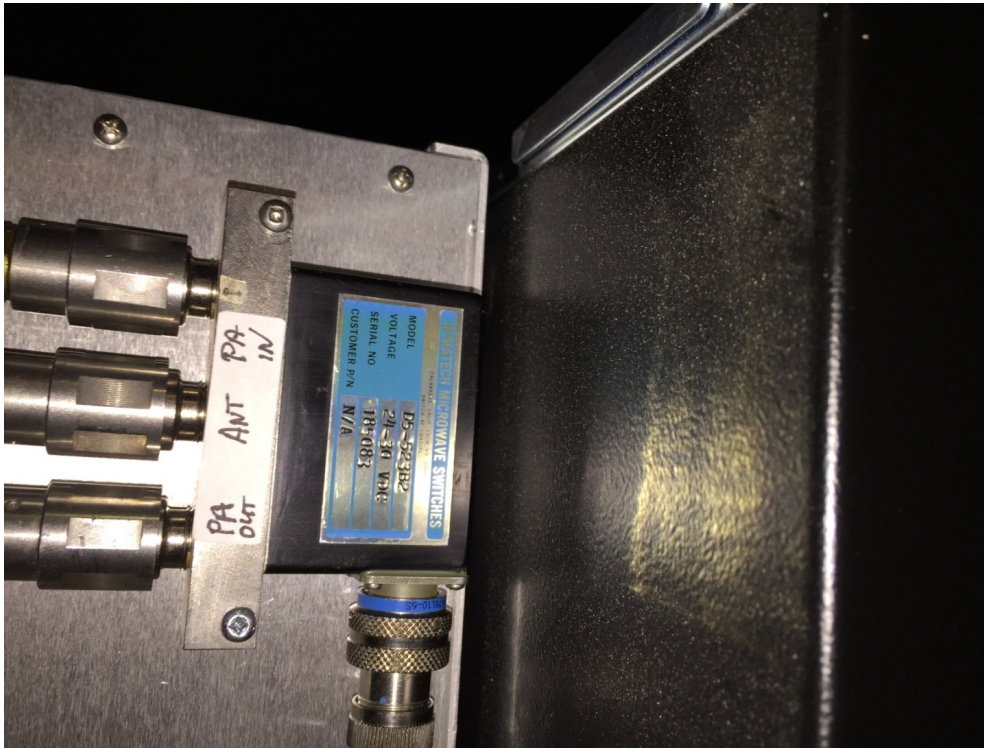


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# Tx-RX relay

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- Must be able to handle high Power— Dynatech rated at 5KW@400 MHz—type SC connectors(hard to find!)
- 2<sup>nd</sup> relay required for high isolation ( Transco SMA measured at 80 db isolation at 1296



## 1296 SSPA Panel -- 7 X16 inches deep

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- Meters read current and forward and reverse power(built in directional coupler)
- Thermal protection
- SWR protection
- Built in sequencer

# Matching Power Supply

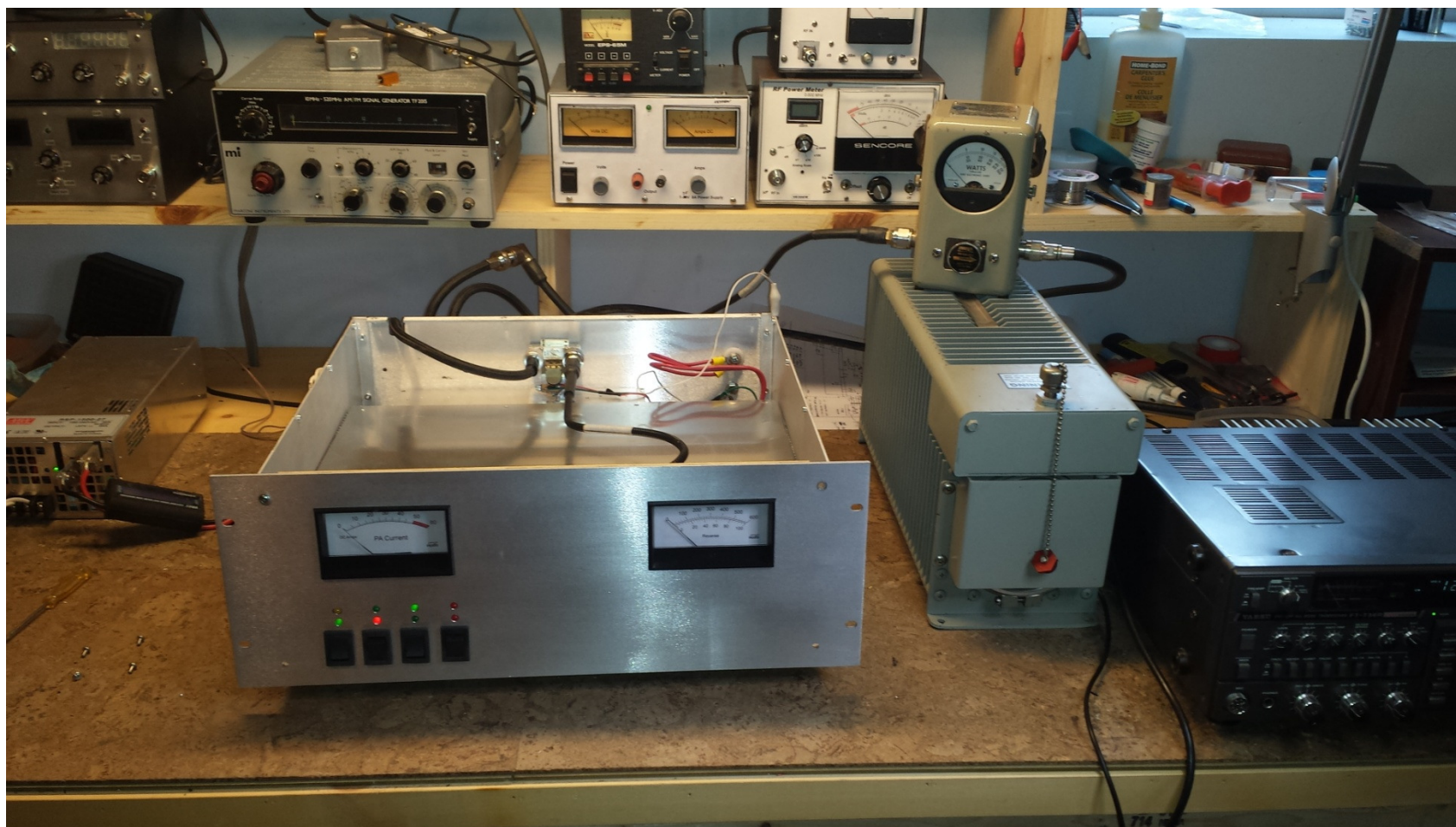
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- Meanwell 28 volt 1500 watt switching supply
- Adjustable to 32 volts –rated to 60 amps
- Excellent regulation, very light weight

# Initial test set up at VE3DEW

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# Initial test set up at VE3DEW

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- Almost 500 watts output from FT 736 R at 10 watts

# Initial test set up at VE2DFO

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# 550 watts output at 1296 MHz

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# Rack Layout for SSPA's

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# Some conclusions and acknowledgements

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## Conclusions:

- Excellent overall performance on 10 -12 watts in for 550 watts output
- 28 volts @ 46 amps around 42% net efficiency after combiner losses.
  - How do you know it really puts out that power?? The coax gets warm!
- I also discovered you need a good preamp at 1296 as close to the antenna switch as possible. —**“You can’t work them if you can’t hear them!”**
  - Reduced the interconnection losses to the amp with LMR600U jumpers.
- Does it work?? January VHF contest ( worse conditions) I worked K1TEO ( FN 31JH) with excellent signals from FN25VJ nearly 500+ Km !

## Acknowledgments:

- -PE1RKI( Bert)—outstanding craftsmanship for the modules
- VE3DEW( Peter) for his metal work and system integration
- VE2XX( Stu) for his support and encouragement