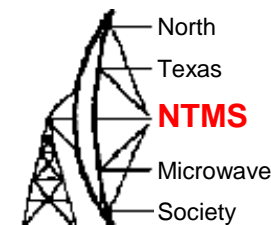W5HN

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Agenda
1. AML Amplifier Modification
2. MicroTik mmW Digital Link
3. Hints and Kinks

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November 3, 2018

AML Amplifier - 1

- Surplus "Brick" Amplifier designed for ~1.9 TO 2.0 MHz PCS service

- Output stage is two enhancement mode MRF19125 FETs in parallel

  - Positive gate supply
  - 125W devices – at 2.0 GHz

- Hybrids, isolator, Ericsson PTH32003 multistage hybrid driver amplifier module all unusable at 2.3 GHz

- 28 VDC supply

- Excellent write-up by WA2AAU in 2006 Eastern States VHF/UHF Conference proceedings

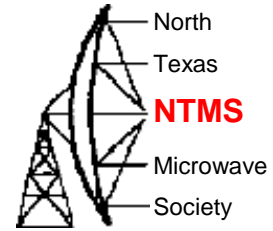 - http://www.mgef.org/amps/presentation/AMLpa6_C.pdf

AML Amplifier - 2

Photo courteous WA2AAU

W5HN

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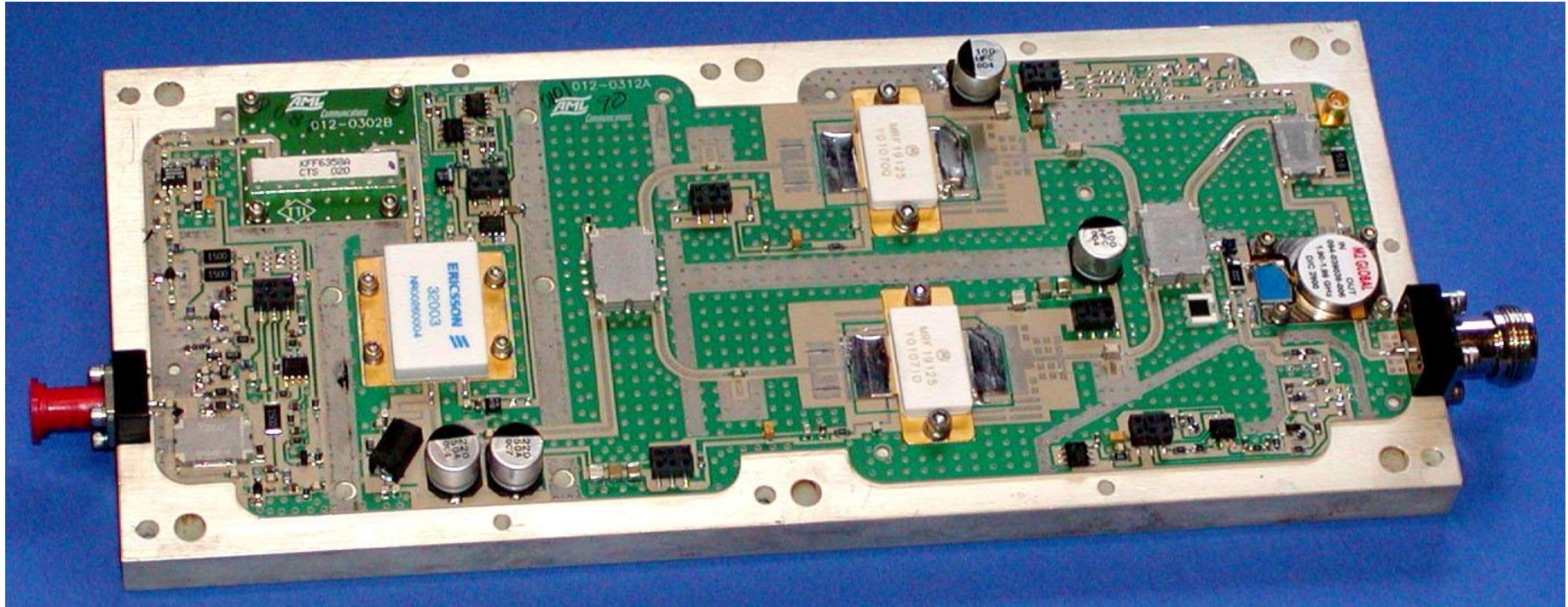Texas
NTMS
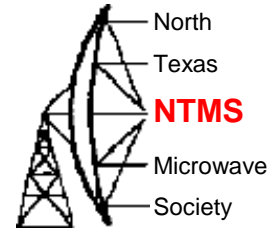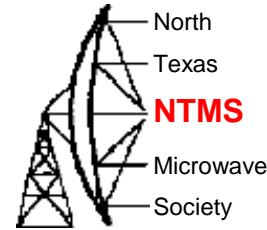Microwave
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# AML Amplifier - 3

Photo courteous WA2AAU

AML Amplifier
AA5C Mods - 1

- Isolate the 2 MRF19125 FETs
  - Include microstrip lines into and out of the 2 MRF19125 – with the decoupling caps.
  - Drain and Gate bias supply lines and decoupling caps
- Isolate the input SMA and output N connectors
- Run UT-085 semi-rigid coax
  - From input SMA to one of the MRF19125s
  - From, the output of first MRF19125 to the input of the 2nd MRF19125
  - From the output of the 2nd MRF19125 to the output N connector
- Make sure the decoupling caps are in-place

Lots of Heat Required to Solder Semi-rigid Coax Shield

AML Amplifier
# AA5C Mods - 2

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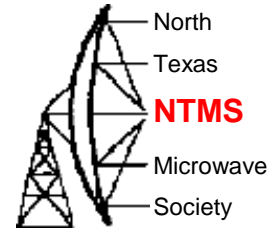
- Modify the input and output matching networks with copper foil tape following WA2AAU's dimensions

- Wire in two small 10-turn 500 ohm trimpots for gate bias
  - Set the trimpots for minimum bias voltage

- Mount the plate to a large heatsink

- Add a 5V regulator to the heatsink and connect to the bias pots

- Solder 12 ga drain supply leads to the bypass caps near the FETs

Expect the Modifications to Take 8 to 10 hours

AML Amplifier
AA5C Mods - 3
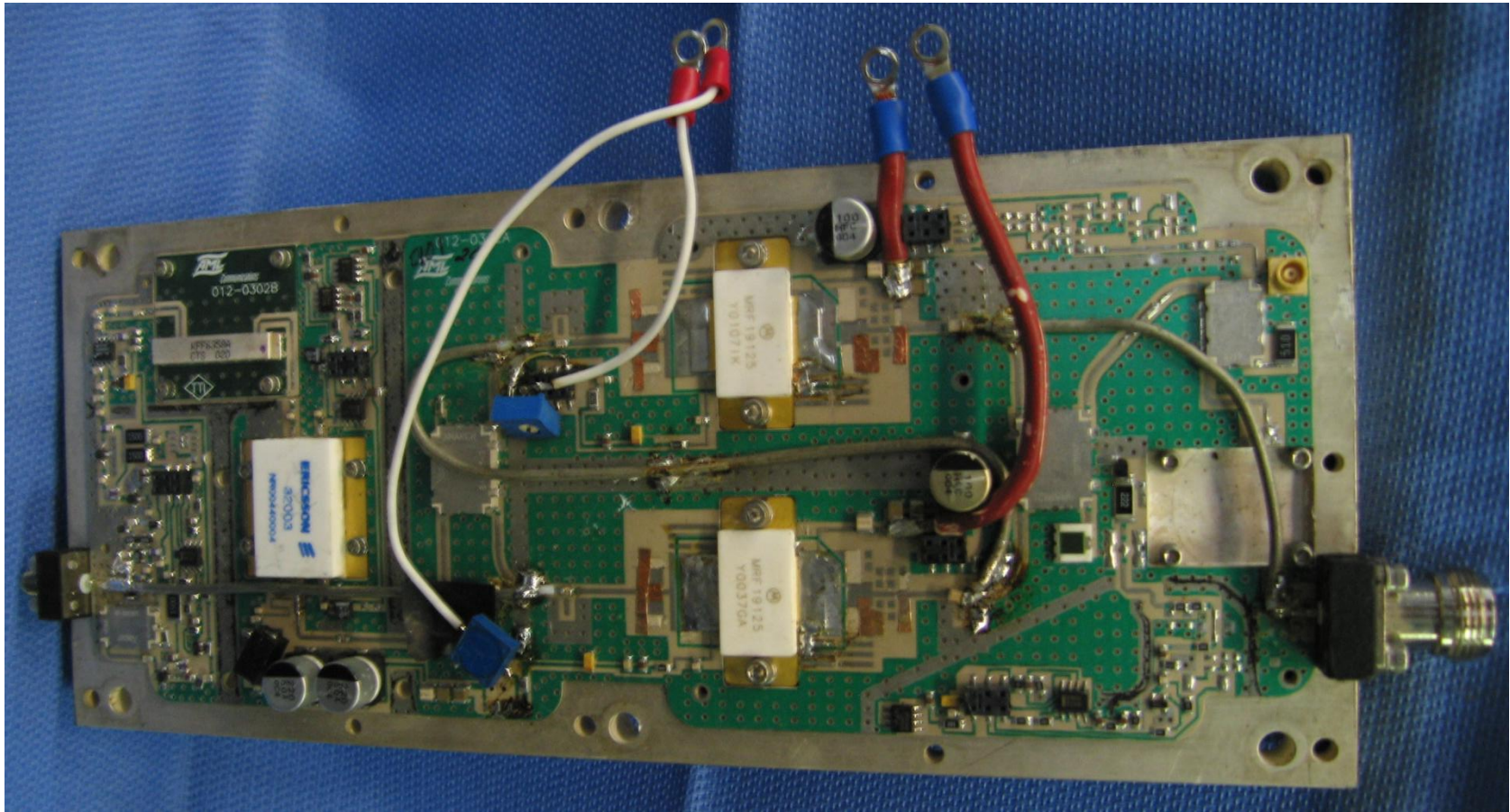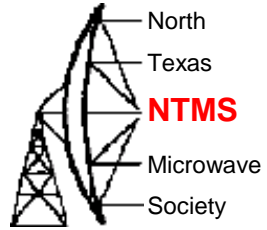
AML Amplifier
DC Adjustments
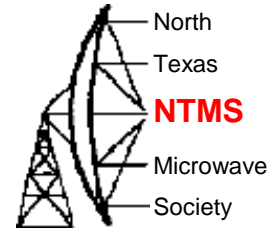
- Apply power to the gate bias circuit ONLY
  - Slowly bring the voltage on each gate up to 2.0 VDC
- Apply 28 volts to the drains and gate bias circuits together
- Slowly adjust the bias pots for 1.3 Amps drain current each FET
  - Around 3.6 to 3.7 VDC bias voltage for this current level

Gate Voltage too High Results in a Brilliant White Flash!

AML Amplifier
RF Adjustments -1
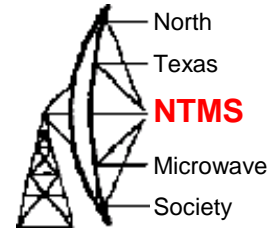
- Connect a 2304 MHz amp capable of several Watts output to the RF input.

- Connect a directional coupler and 100 Watt dummy load to the RF output.

- Connect a RF power meter and suitable pads to the directional coupler for measuring the output power

- Apply 28 volts to the drains and gate bias circuits together

AML Amplifier
RF Adjustments - 2

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- SLOWLY bring up the 2304 MHz drive and check output power

- Check and adjust the input and output matching networks for maximum output power

- I quit when I got 70 Watts output with 1.6 Watts of drive
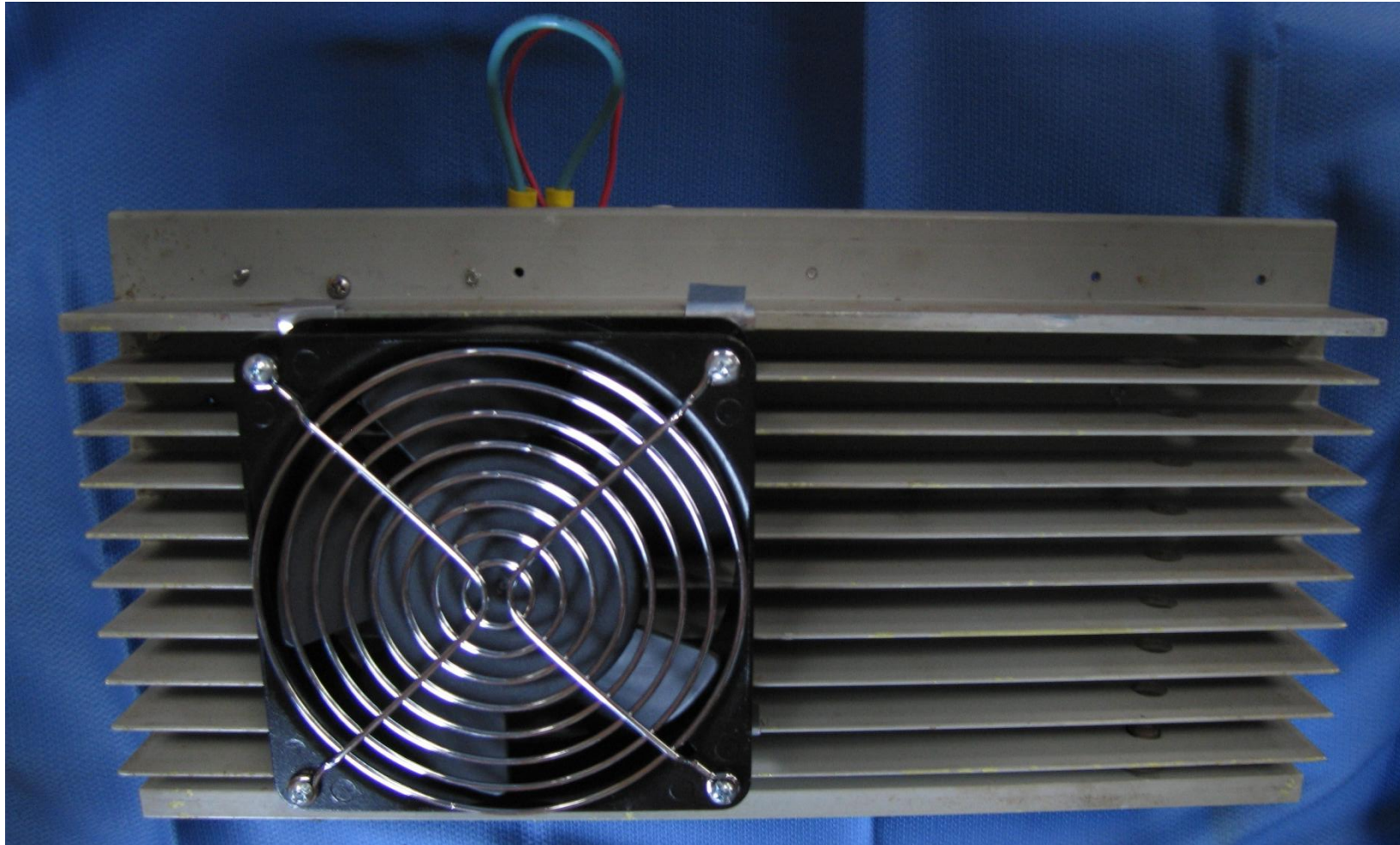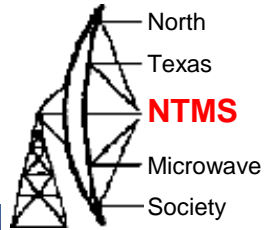
DO NOT Overdrive the Input FET

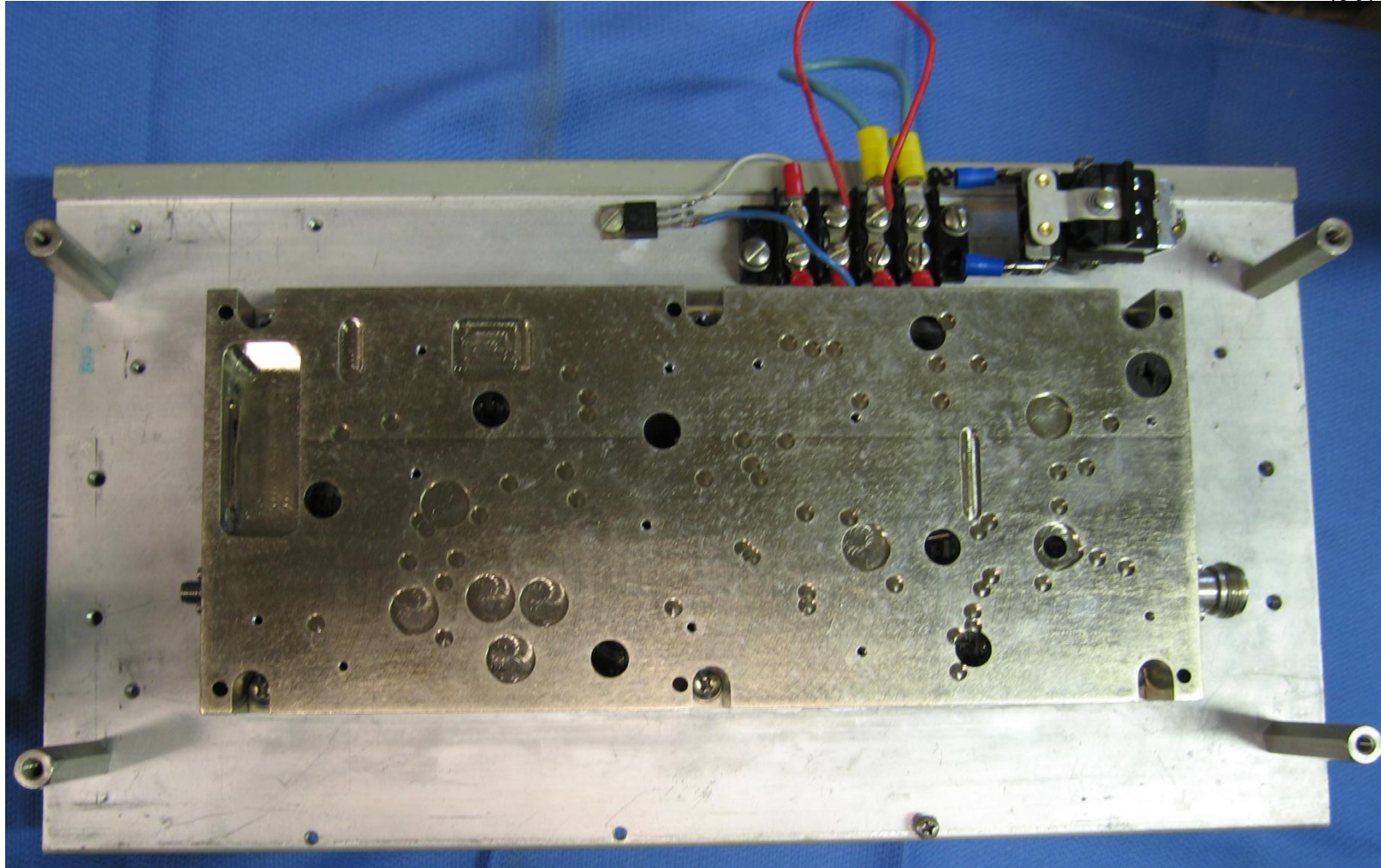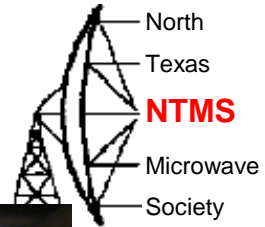# AML Amplifier
AA5C Results

- With 1.6 Watts input, 70 Watts (+58.5 dBm) output
  - Overall gain: 16.4 dB
- 15 Amps current on 28 VDC supply for this output level
  - 420 Watts
  - Overall efficiency ~ 17%
  - Heat sink needs to handle 350 Watts of waste heat

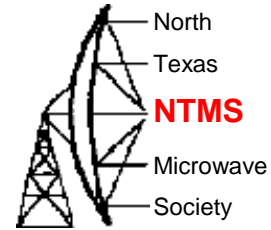Big Heatsink and Lots of Cooling Air Needed

AML Amplifier Assembly
Top View

AML Amplifier Assembly Bottom View

AML Amplifier Suggestions

- Use a 20A relay to key the amplifier only during transmit
  - Bias current alone dissipates 73 Watts
- Add a cover
  - I used the center section of the original housing by milling out walls and adding notches
  - Cover the feed-through holes with aluminum or copper tape

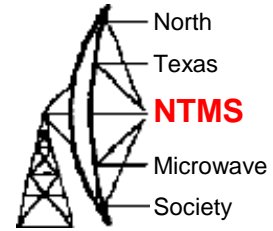Big Heatsink and Lots of Cooling Air Needed

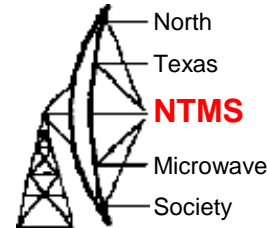# AML Amplifier – Cover
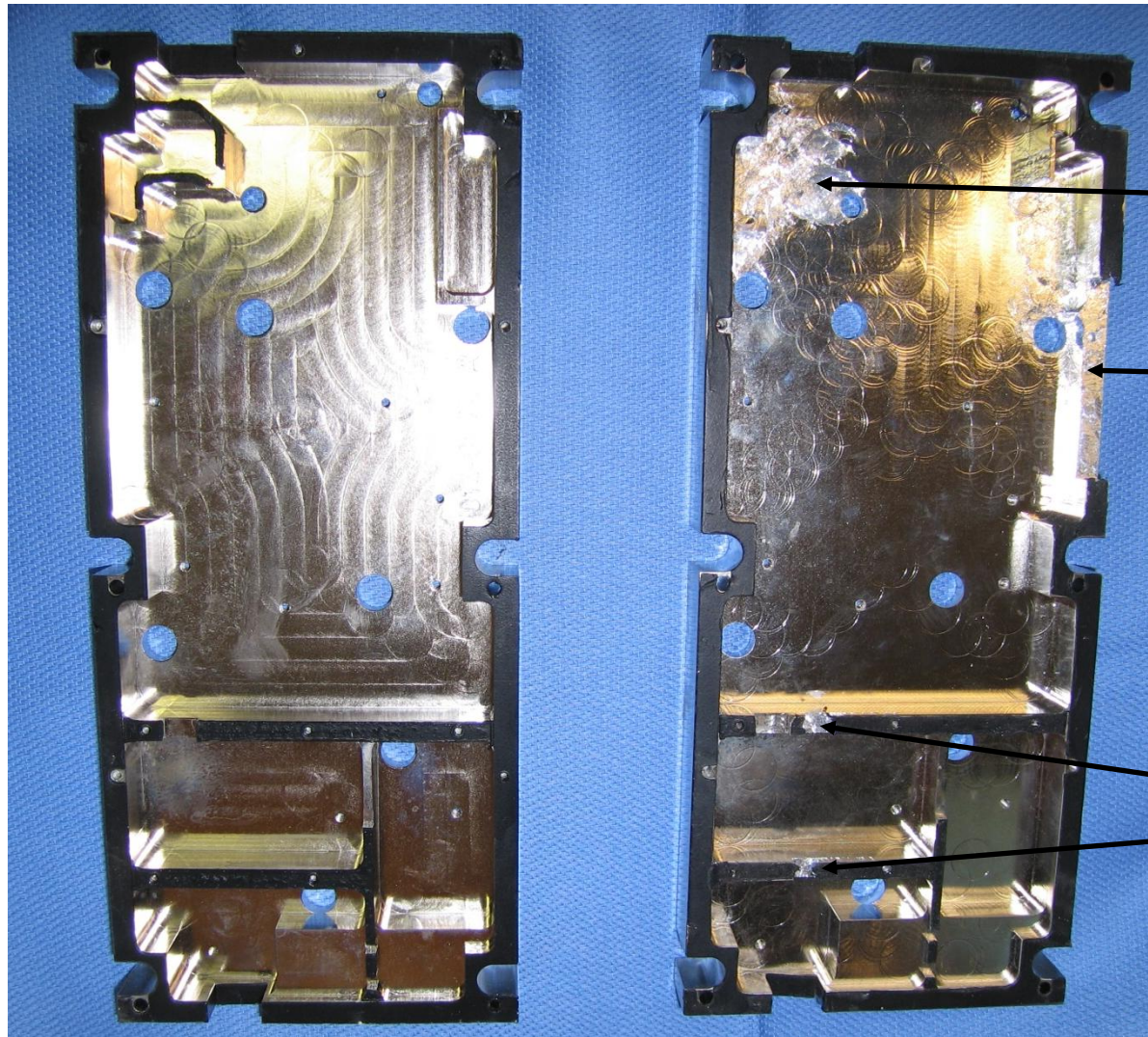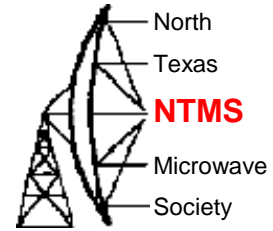
Remove shield wall

Notch for Power and Bias Wires

Notches for input UT-085 coax

MicroTik mmW Link - 1

MicroTik mmW Link - 2

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- CPU IPQ-4019 716 MHz CPU core count: 4

- Size of RAM: 256 MB

- 10/100/1000 Ethernet ports: 1

- Wireless Built-in 60 GHz 802.11ad

- Antenna beam width Phase array 60° beamforming

- Range: 200 meters

- PoE in: Yes

- Supported input voltage: 12 V - 57 V (802.3af/at)

- License level: 3

- Operating System: RouterOS

- Max Power consumption: 5 W

Hints and Kinks Plus Lessons Relearned From Murphy
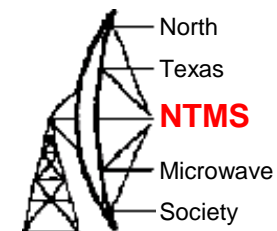
- Unsecured SMA center pins can migrate into insulator
  - Not DC connected but still pass signals – 10 dB down
  - Use "connector saver"
- Flex Seal Spray - Phil Swift didn't think of this one
  - Use to seal coax – open braid and connectors
  - Mask carefully what you don't want covered
  - RF unimpacted to at least 2M
- Antenna Ranges
  - Avoid reflections from structures above or beside you – they interfere with measurements
  - Always be in the far range: $>2D^2/\lambda$