

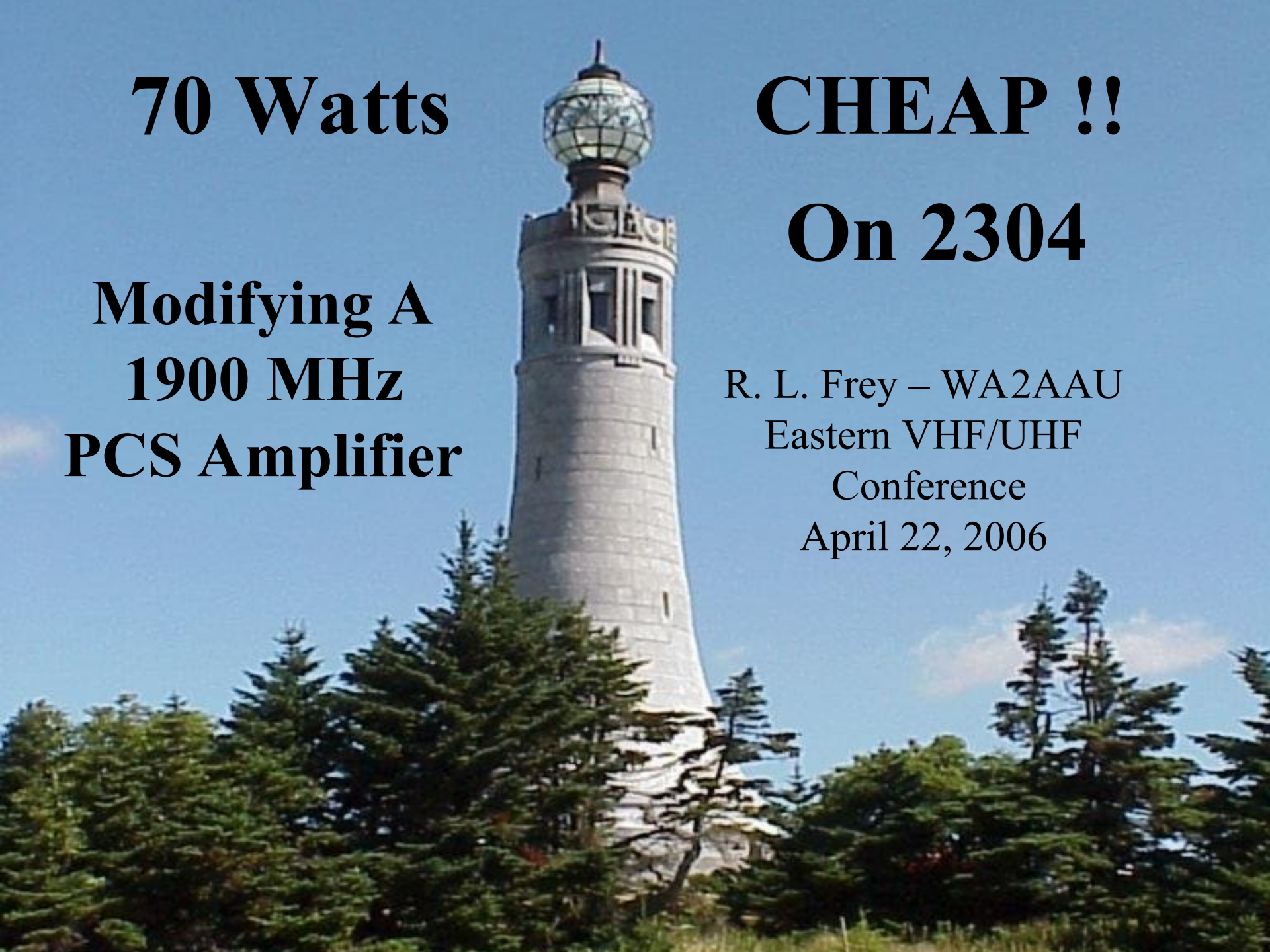
70 Watts

CHEAP !!

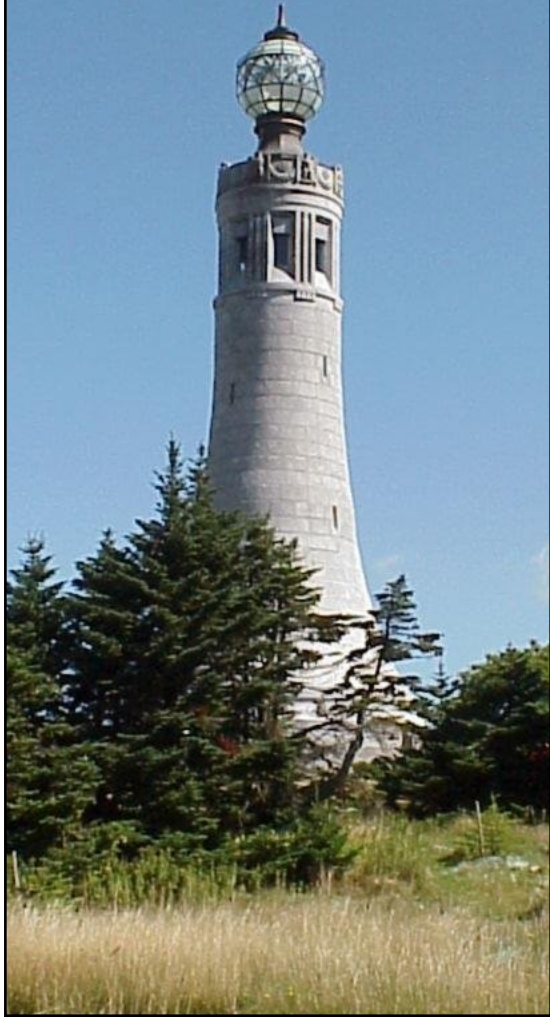
On 2304

**Modifying A
1900 MHz
PCS Amplifier**

R. L. Frey – WA2AAU
Eastern VHF/UHF
Conference
April 22, 2006



**W2SZ/1
(The MGEF)**



1900 MHz PCS Amplifier

Lots of Them In Use

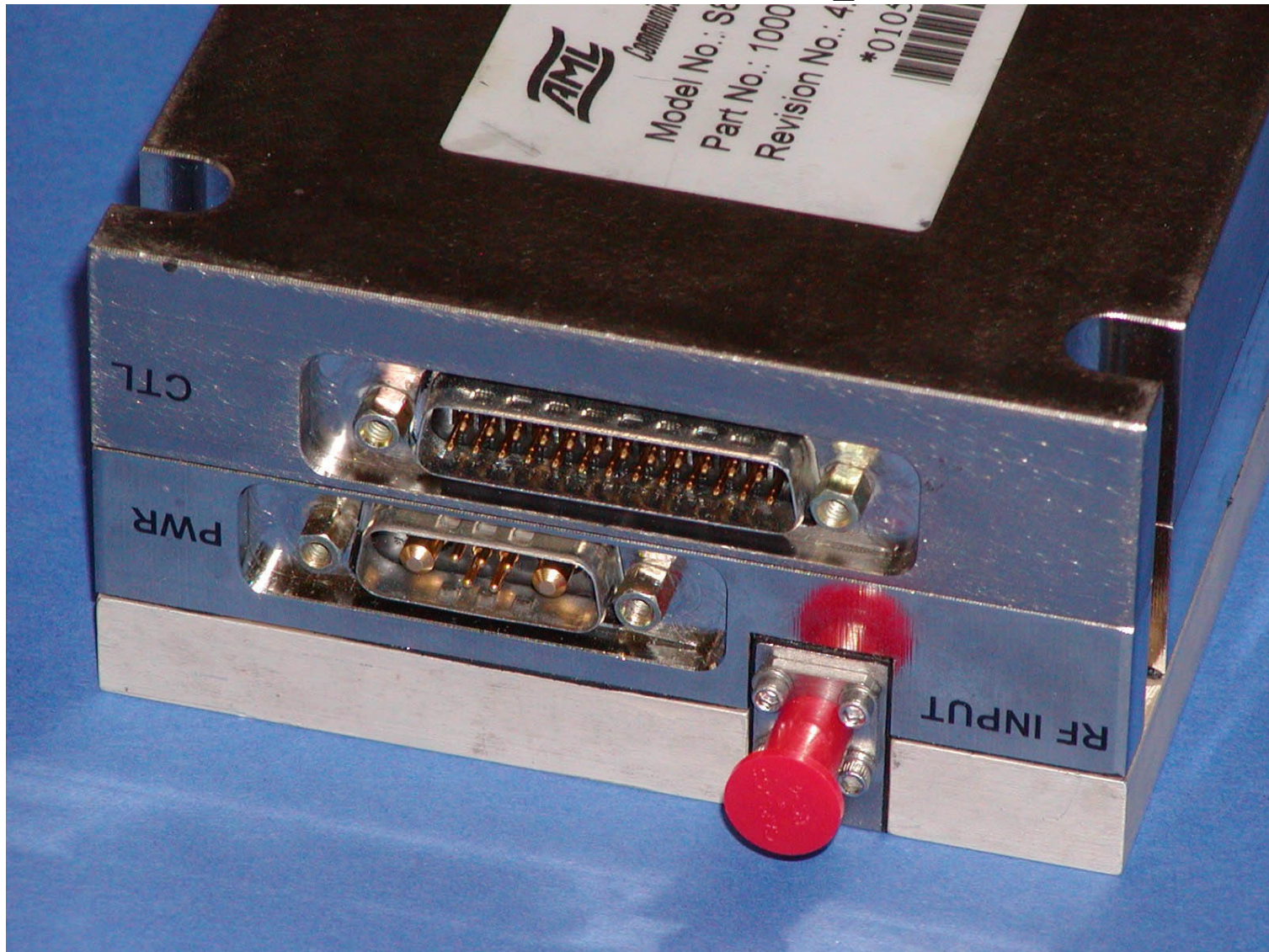
Some Now Surplus...

- Wouldn't It Be Nice If We Could USE THEM???
- Surprise!! WE CAN!!

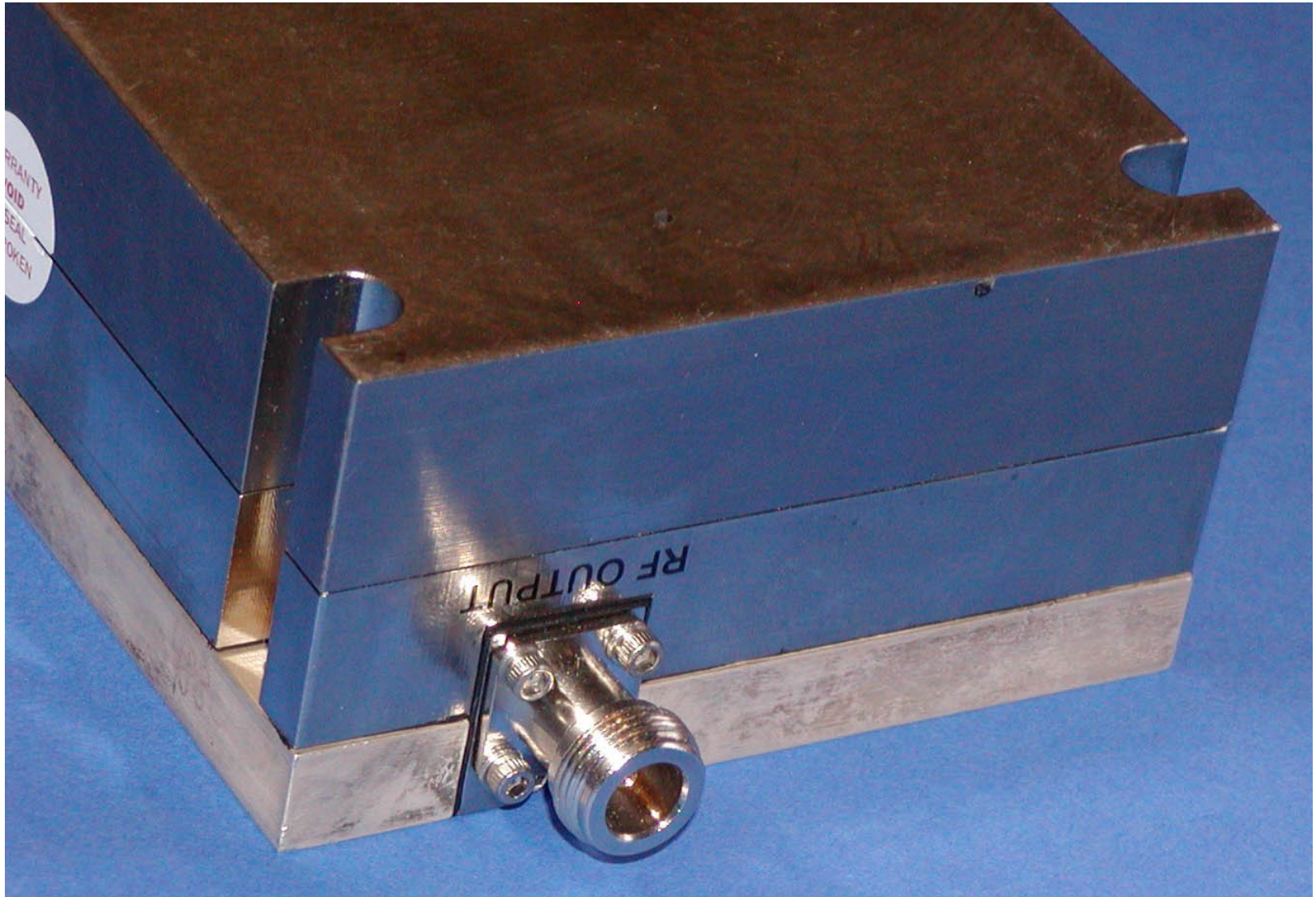
The AML PCS Amplifier



The AML PCS Amplifier

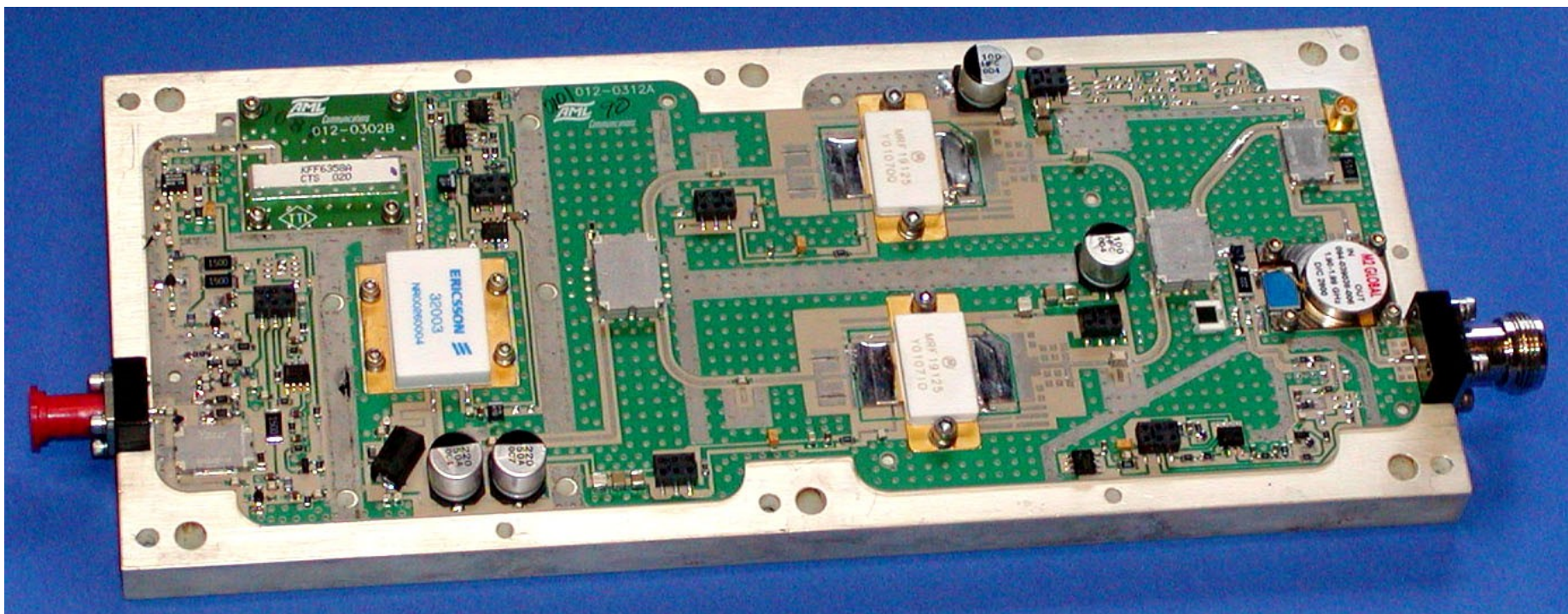


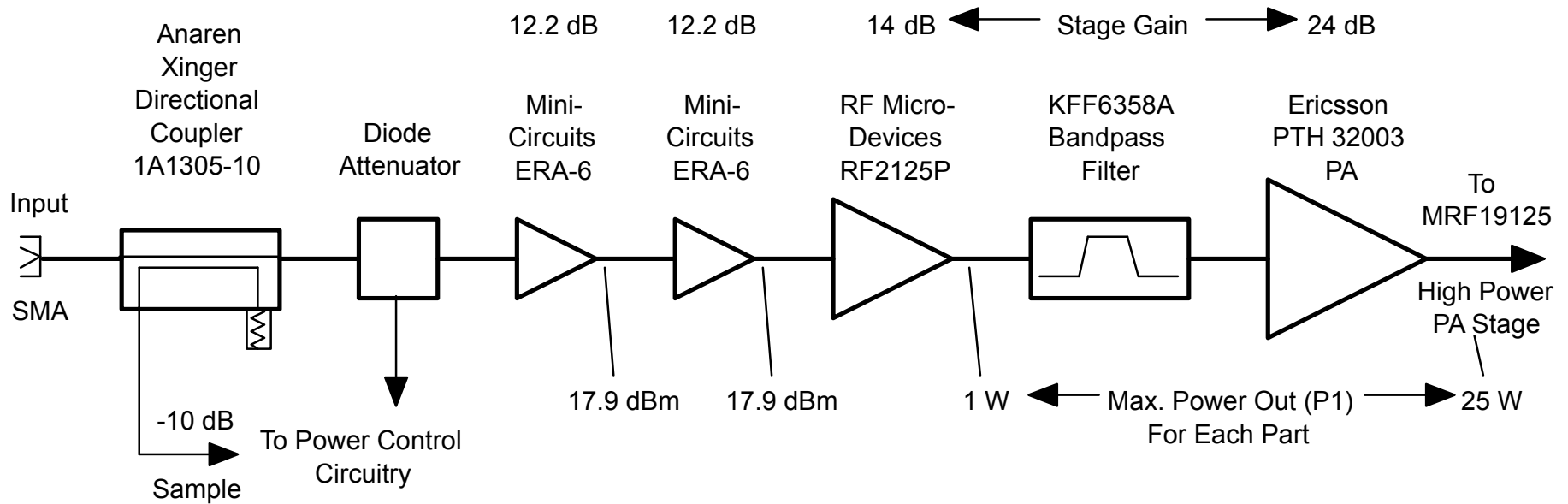
The AML PCS Amplifier



The AML PCS Amplifier

RF Amplifier Base Plate



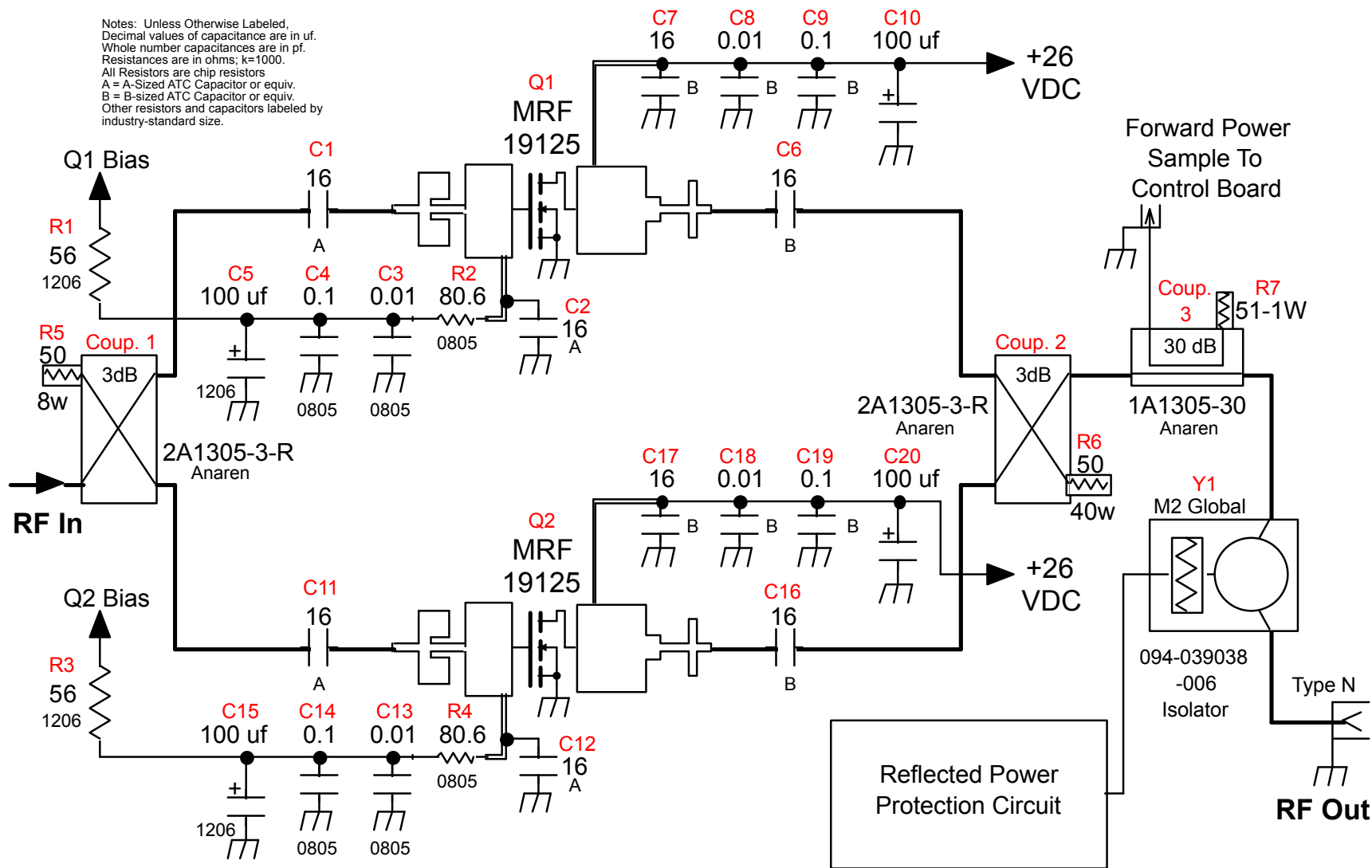


AML PCS Power Amplifier - Driver Stages

Model No. S80PCSA Part No. 1000103P1 Rev. 4

RLF
2/27/2006
DrvBlk2.cdd

Notes: Unless Otherwise Labeled,
 Decimal values of capacitance are in uf.
 Whole number capacitances are in pf.
 Resistances are in ohms; k=1000.
 All Resistors are chip resistors
 A = A-Sized ATC Capacitor or equiv.
 B = B-sized ATC Capacitor or equiv.
 Other resistors and capacitors labeled by
 industry-standard size.



Drawn From Inspection
 R. L. Frey - May 10, 2005

AML PCS Power Amplifier - Final Stage

Model No. S80PCSA Part No. 1000103P1 Rev. 4

70 Watts CHEAP !! On 2304 MHz

R. L. Frey - WA2AAU

Eastern VHF Conf. 4/2006

The RF Sub-Micron MOSFET Line

RF Power Field Effect Transistors

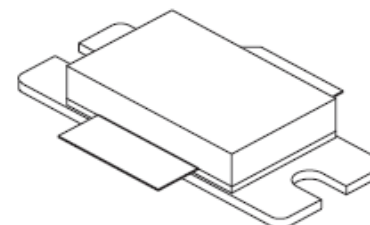
N-Channel Enhancement-Mode Lateral MOSFETs

Designed for PCN and PCS base station applications with frequencies from 1.9 to 2.0 GHz. Suitable for TDMA, CDMA and multicarrier amplifier applications.

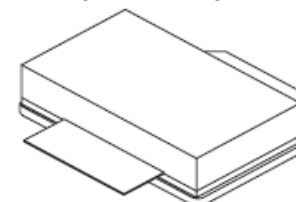
- Typical 2-Carrier N-CDMA Performance for $V_{DD} = 26$ Volts, $I_{DQ} = 1300$ mA, $f_1 = 1958.75$ MHz, $f_2 = 1961.25$ MHz
IS-95 CDMA (Pilot, Sync, Paging, Traffic Codes 8 Through 13)
1.2288 MHz Channel Bandwidth Carrier. Adjacent Channels Measured over a 30 kHz Bandwidth at $f_1 - 885$ kHz and $f_2 + 885$ kHz. Distortion Products Measured over 1.2288 MHz Bandwidth at $f_1 - 2.5$ MHz and $f_2 + 2.5$ MHz. Peak/Avg. = 9.8 dB @ 0.01% Probability on CCDF.
Output Power — 24 Watts Avg.
Power Gain — 13.6 dB
Efficiency — 22%
ACPR — -51 dB
IM3 — -37.0 dBc
- Internally Matched, Controlled Q, for Ease of Use
- High Gain, High Efficiency and High Linearity
- Integrated ESD Protection
- Designed for Maximum Gain and Insertion Phase Flatness
- Capable of Handling 5:1 VSWR, @ 26 Vdc, 1990 MHz, 125 Watts (CW) Output Power
- Excellent Thermal Stability
- Characterized with Series Equivalent Large-Signal Impedance Parameters
- Available in Tape and Reel. R3 Suffix = 250 Units per 56 mm, 13 inch Reel.

MRF19125
MRF19125S
MRF19125SR3

1990 MHz, 125 W, 26 V
LATERAL N-CHANNEL
RF POWER MOSFETs



CASE 465B-03, STYLE 1
(NI-880)
(MRF19125)



CASE 465C-02, STYLE 1
(NI-880S)
(MRF19125S)

MRF19125 Transistor

ELECTRICAL CHARACTERISTICS — continued ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
FUNCTIONAL TESTS (In Motorola Test Fixture)					
Two-Tone Common-Source Amplifier Power Gain ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 125\text{ W PEP}$, $I_{DQ} = 1300\text{ mA}$, $f_1 = 1930\text{ MHz}$, $f_2 = 1990\text{ MHz}$, Tone Spacing = 100 kHz)	G_{ps}	—	13.5	—	dB
Two-Tone Drain Efficiency ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 125\text{ W PEP}$, $I_{DQ} = 1300\text{ mA}$, $f_1 = 1930\text{ MHz}$, $f_2 = 1990\text{ MHz}$, Tone Spacing = 100 kHz)	η	—	35	—	%
Third Order Intermodulation Distortion ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 125\text{ W PEP}$, $I_{DQ} = 1300\text{ mA}$, $f_1 = 1930\text{ MHz}$, $f_2 = 1990\text{ MHz}$, Tone Spacing = 100 kHz)	IMD	—	-30	—	dBc
Input Return Loss ($V_{DD} = 26\text{ Vdc}$, $P_{out} = 125\text{ W PEP}$, $I_{DQ} = 1300\text{ mA}$, $f_1 = 1930\text{ MHz}$, $f_2 = 1990\text{ MHz}$, Tone Spacing = 100 kHz)	IRL	—	-13	—	dB
$P_{out, 1\text{ dB}}$ Compression Point ($V_{DD} = 26\text{ Vdc}$, $I_{DQ} = 1300\text{ mA}$, $f = 1990\text{ MHz}$)	P1dB	—	130	—	W

MRF19125 Transistor

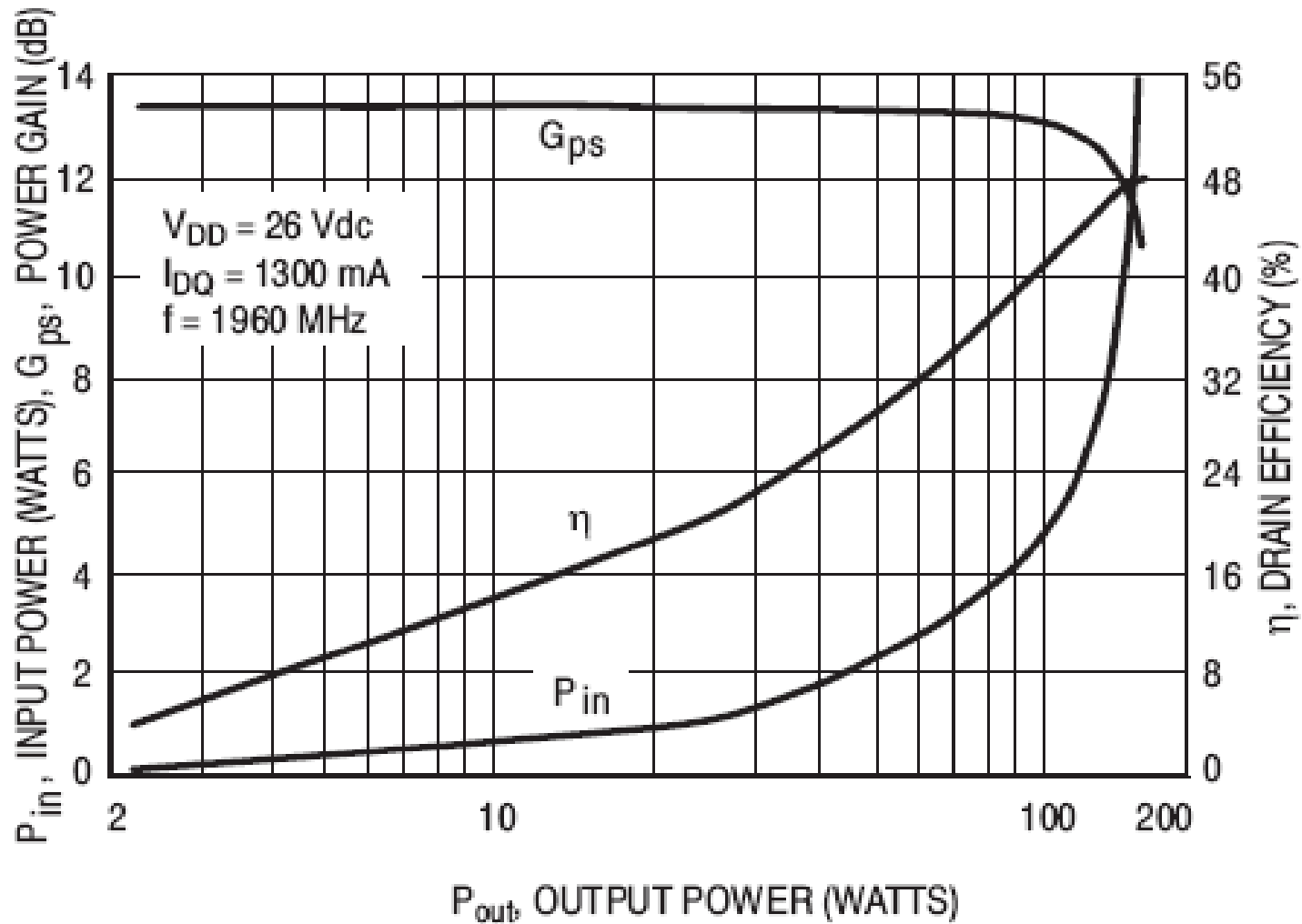
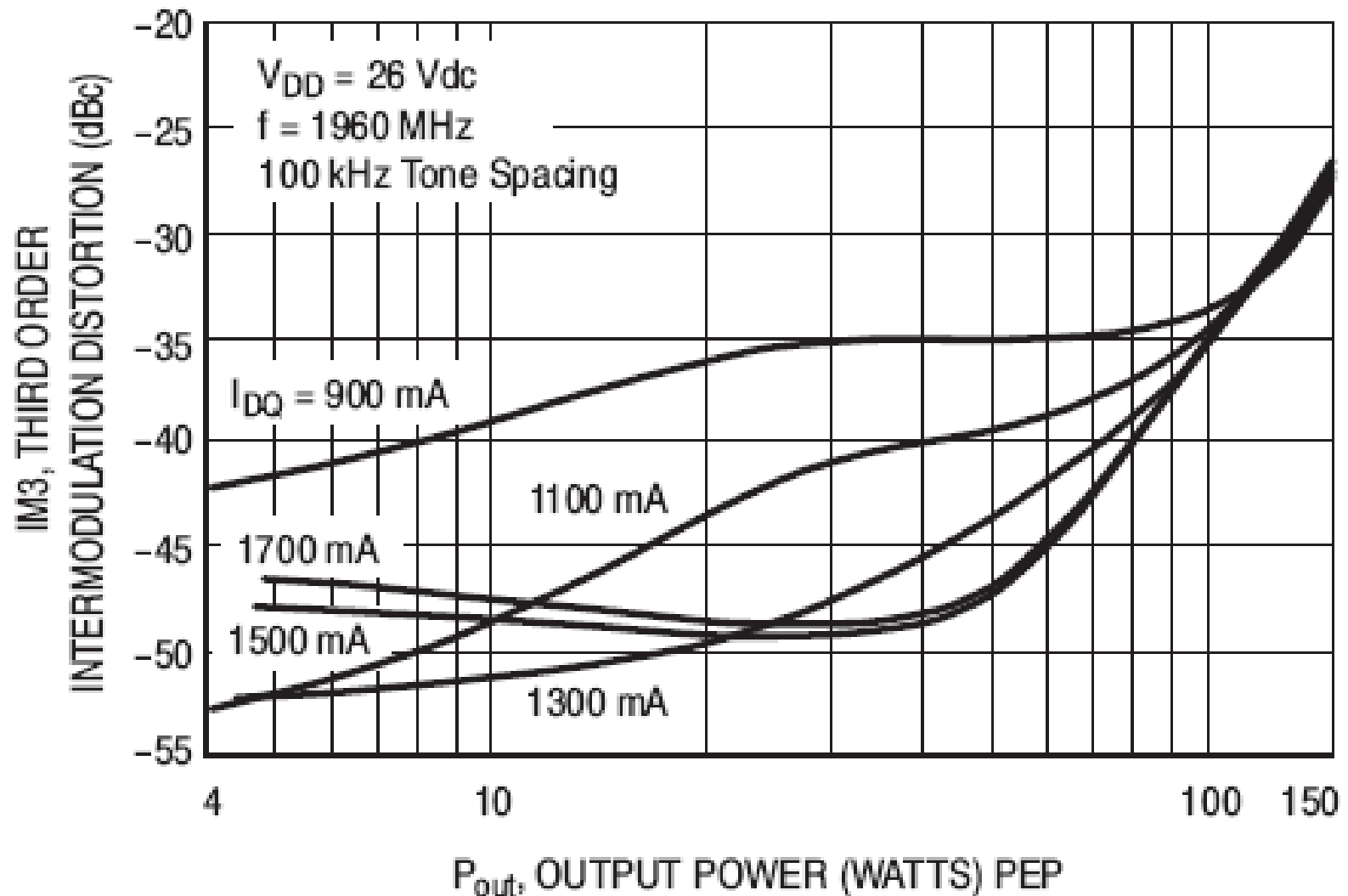
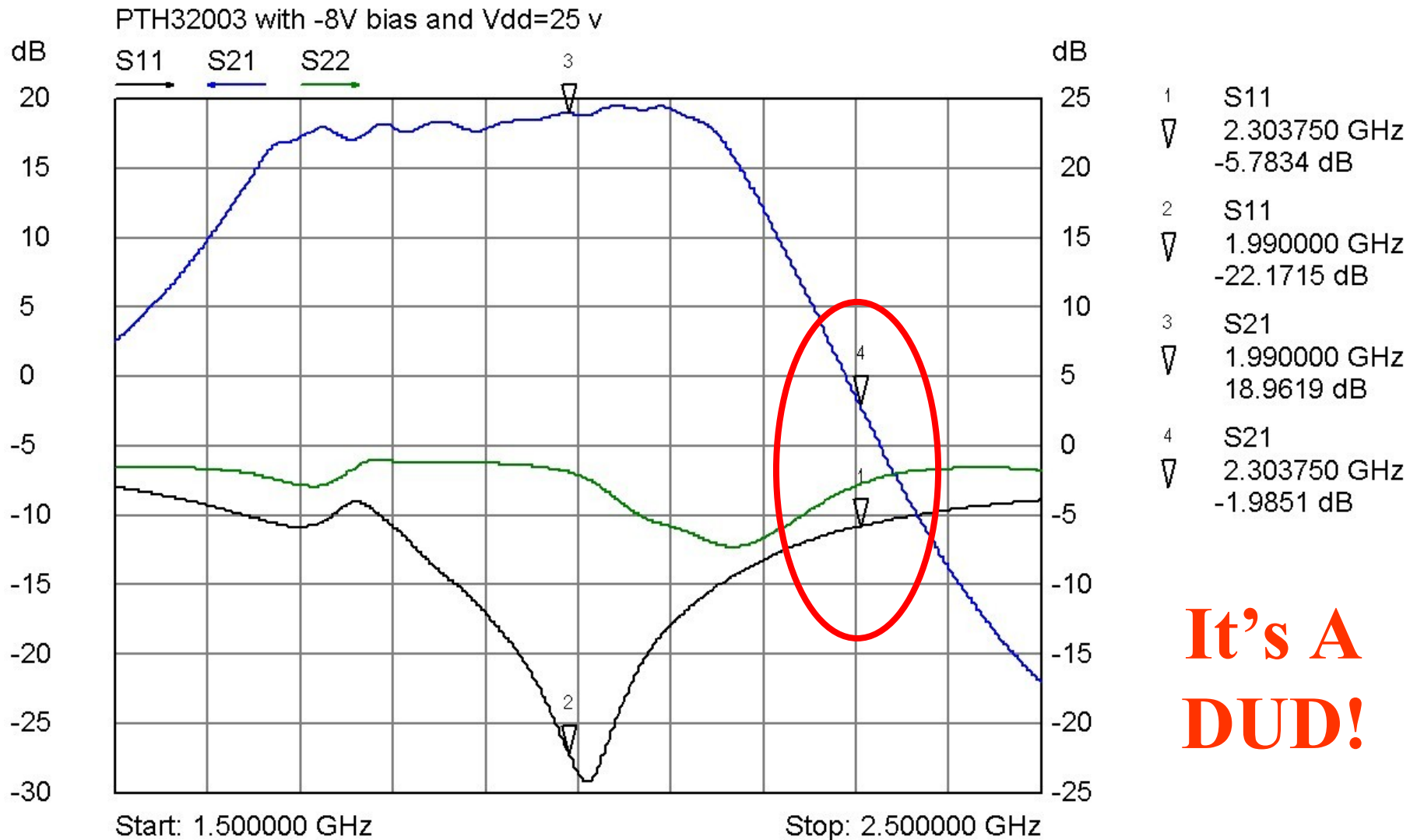


Figure 7. CW Performance

MRF19125 Transistor

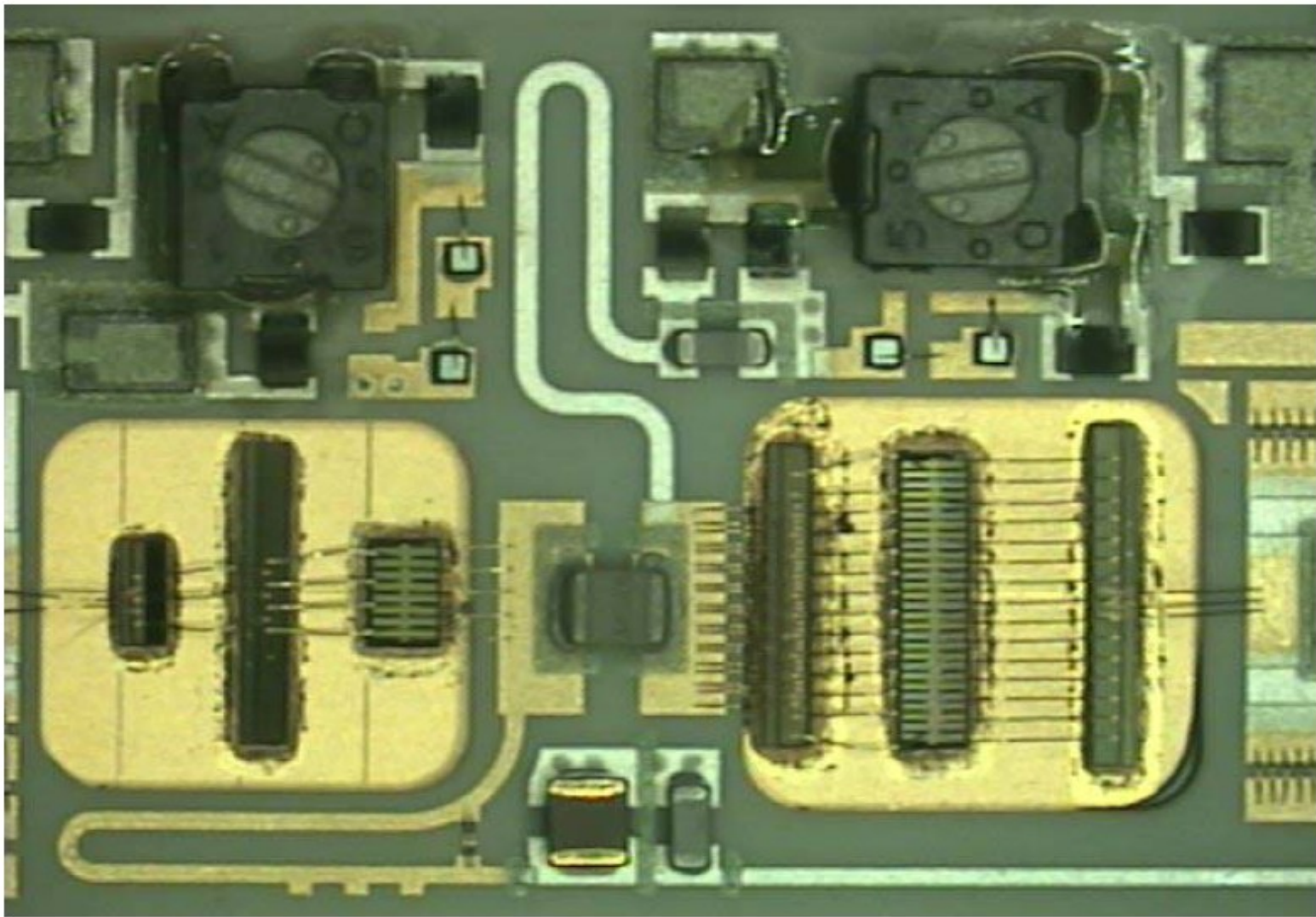


Ericsson PTH32003

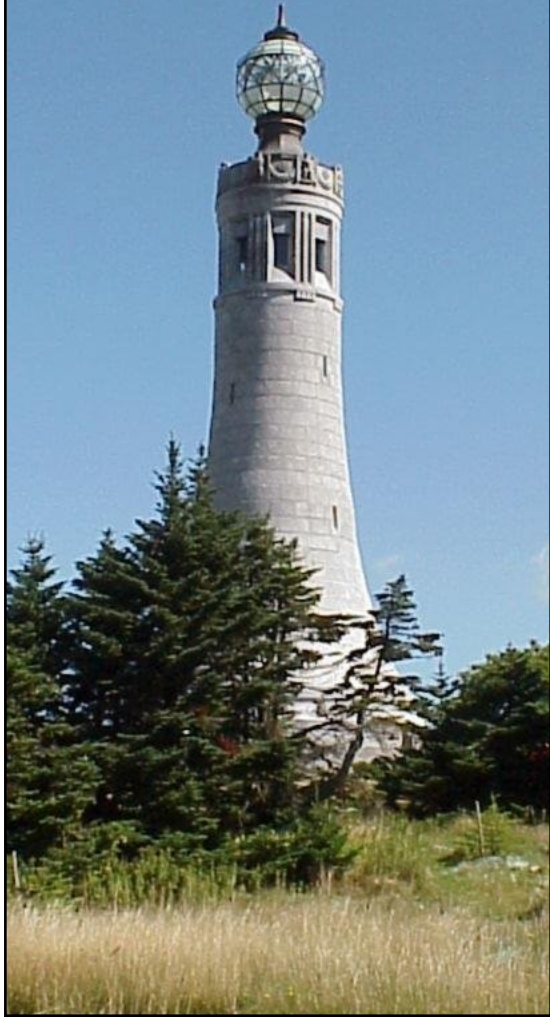


**It's A
DUD!**

Ericsson PTH 32003

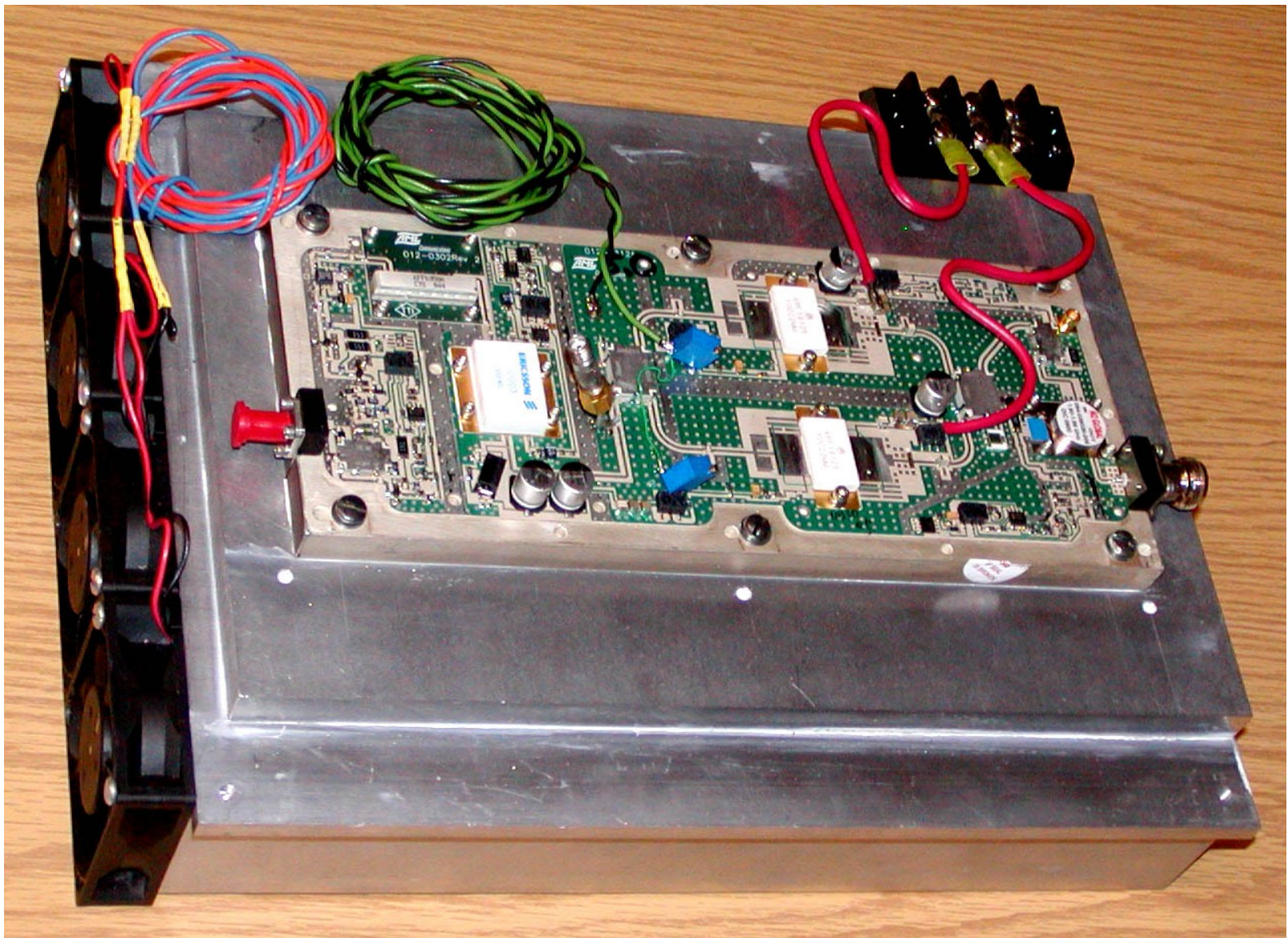


W2SZ/1 (The MGEF)

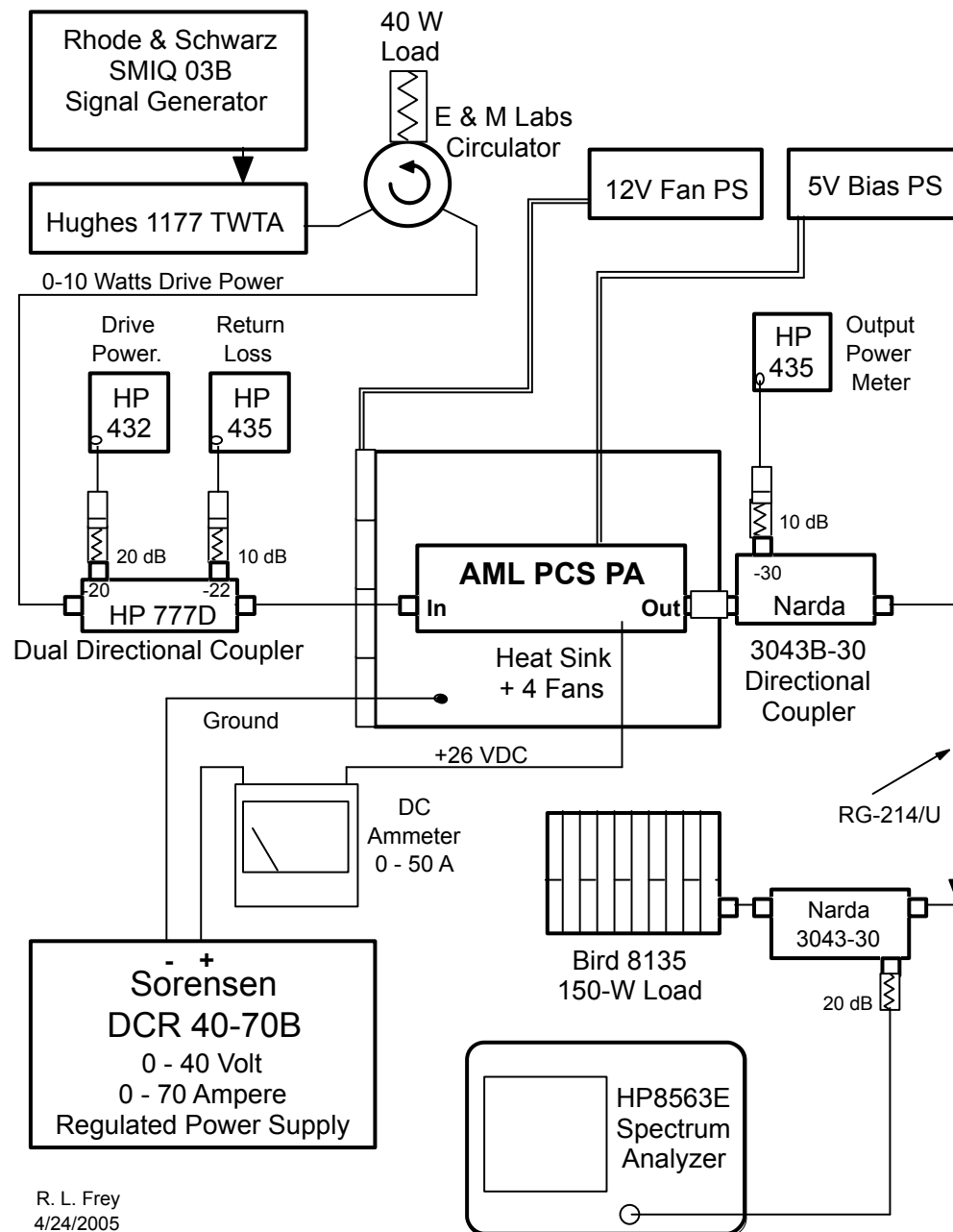


Ericsson PTH 32003

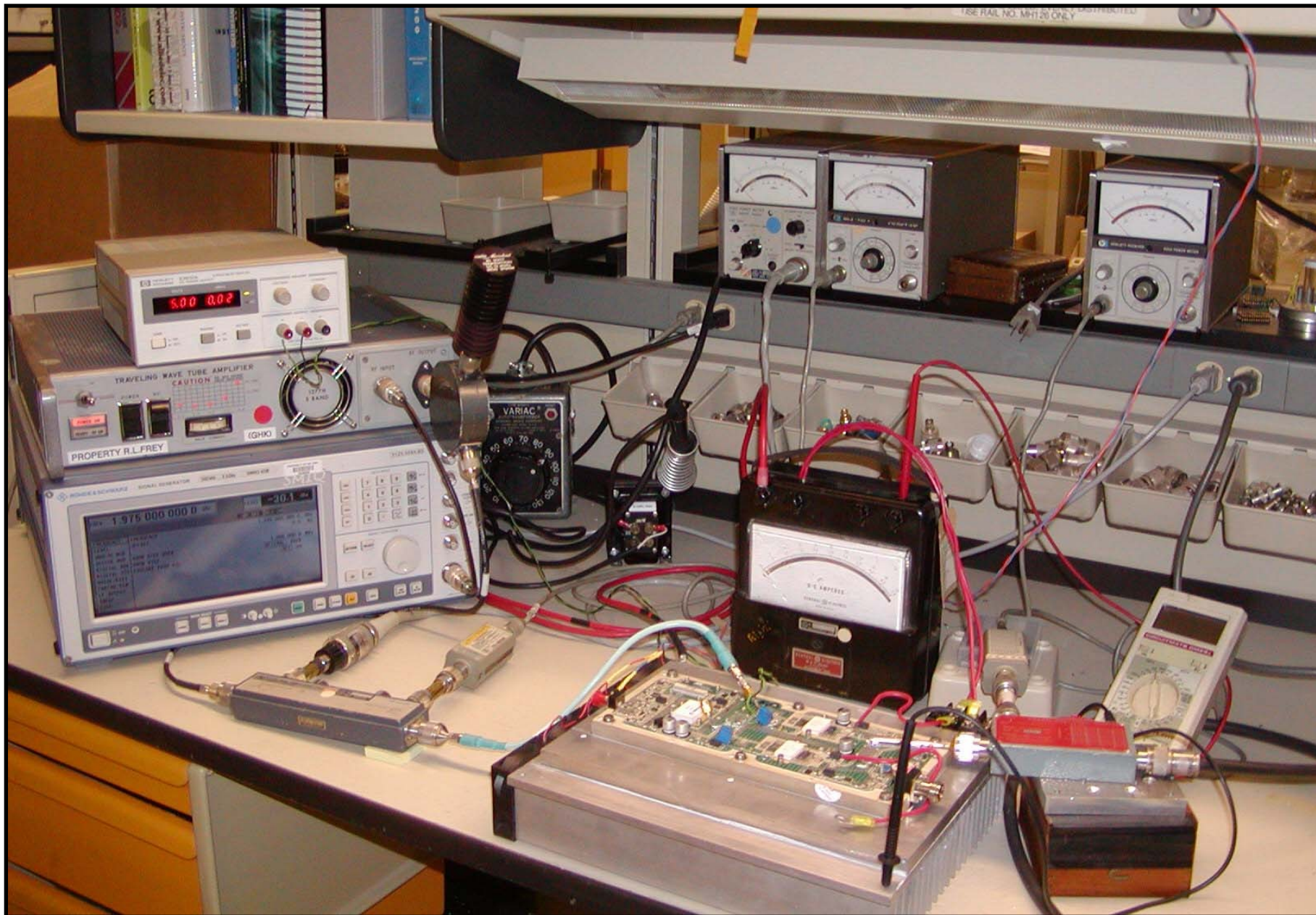
- Lots of internal matching stuff
- Not likely it can be made to work by matching it externally
- Sadly, this part won't work for us
- We could have used a driver!!



AML Amplifier Mounted to Heat Sink with Fans for Testing



R. L. Frey
 4/24/2005



R. L. Frey - WA2AAU

70 Watts CHEAP !! On 2304 MHz

Eastern VHF Conf. 4/2006

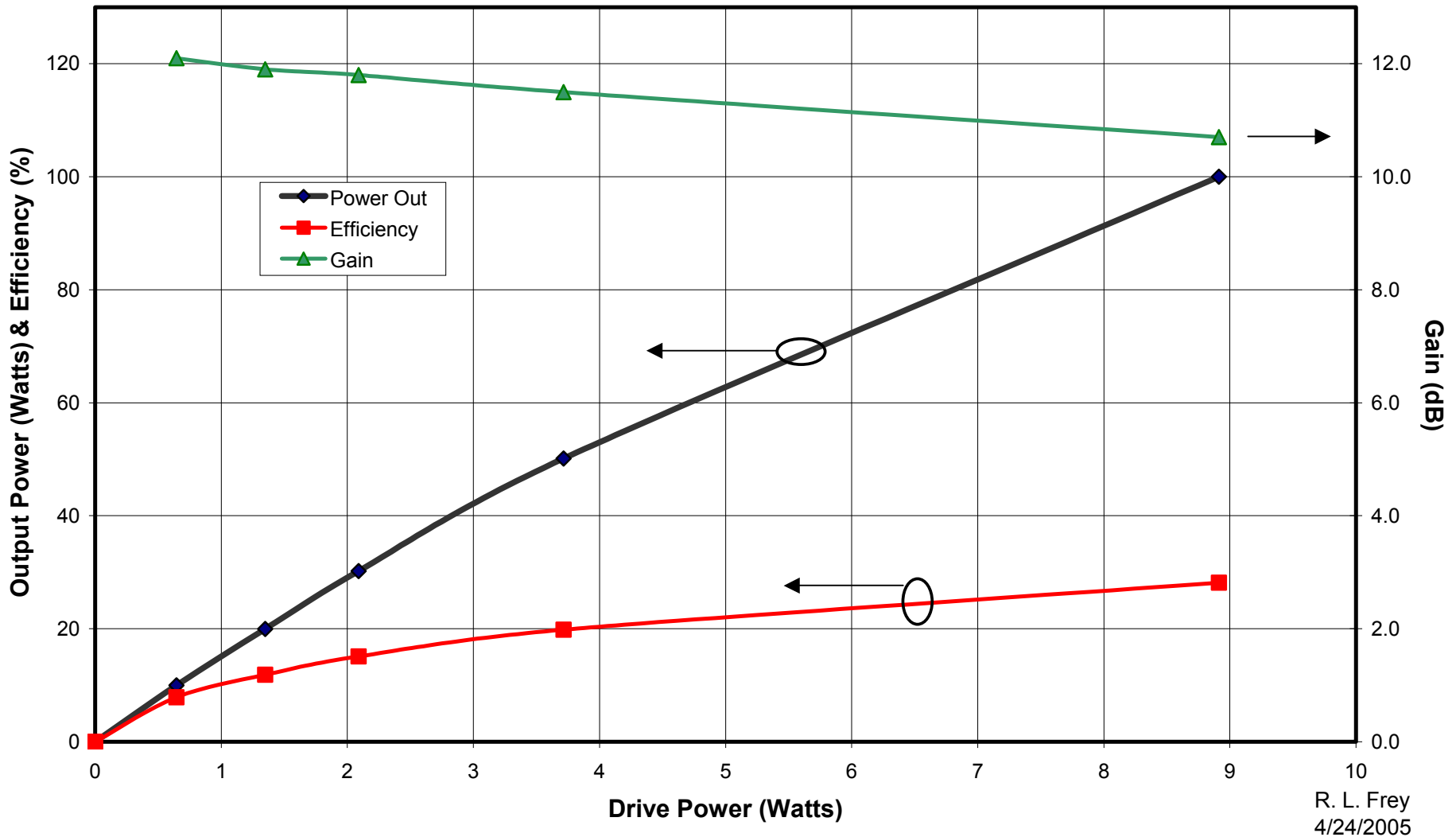


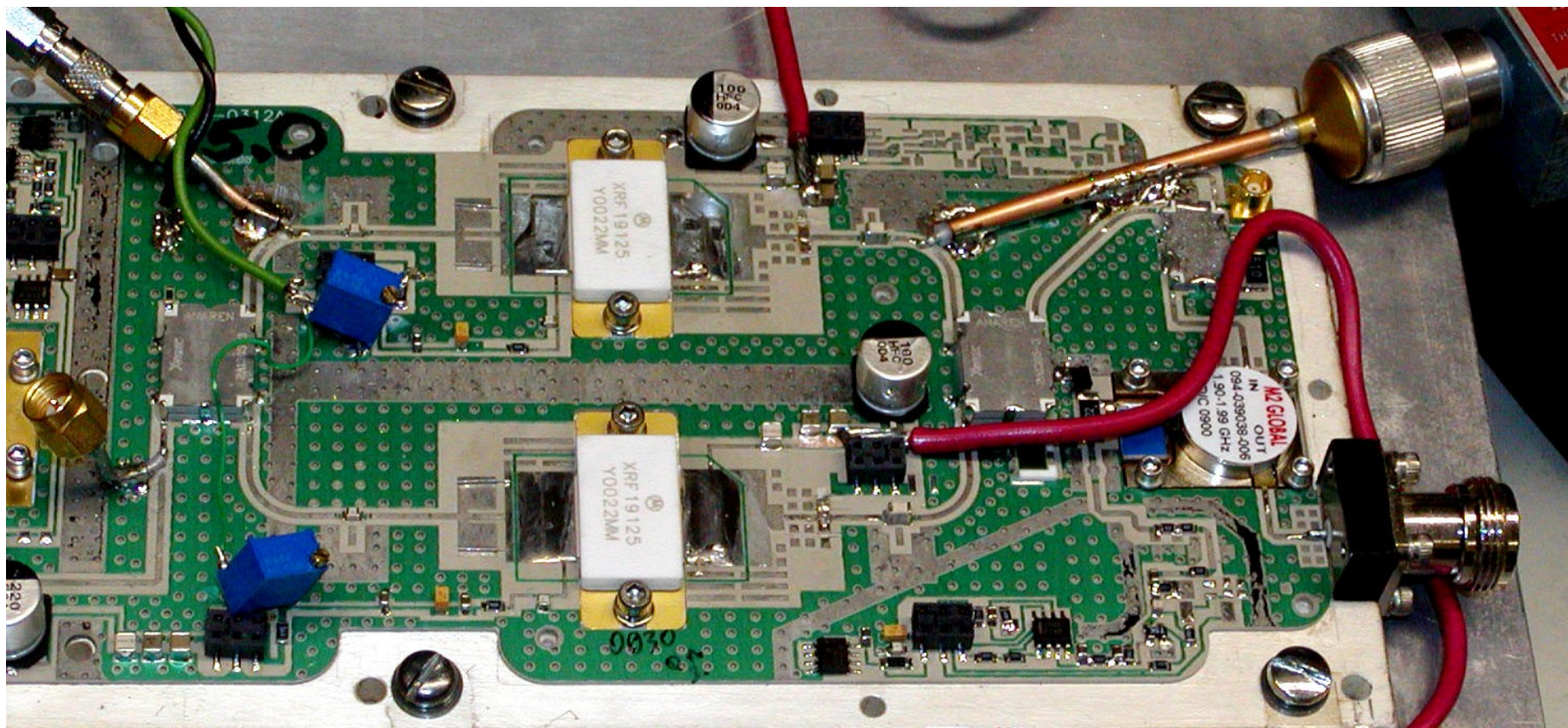
R. L. Frey - WA2AAU

70 Watts CHEAP !! On 2304 MHz

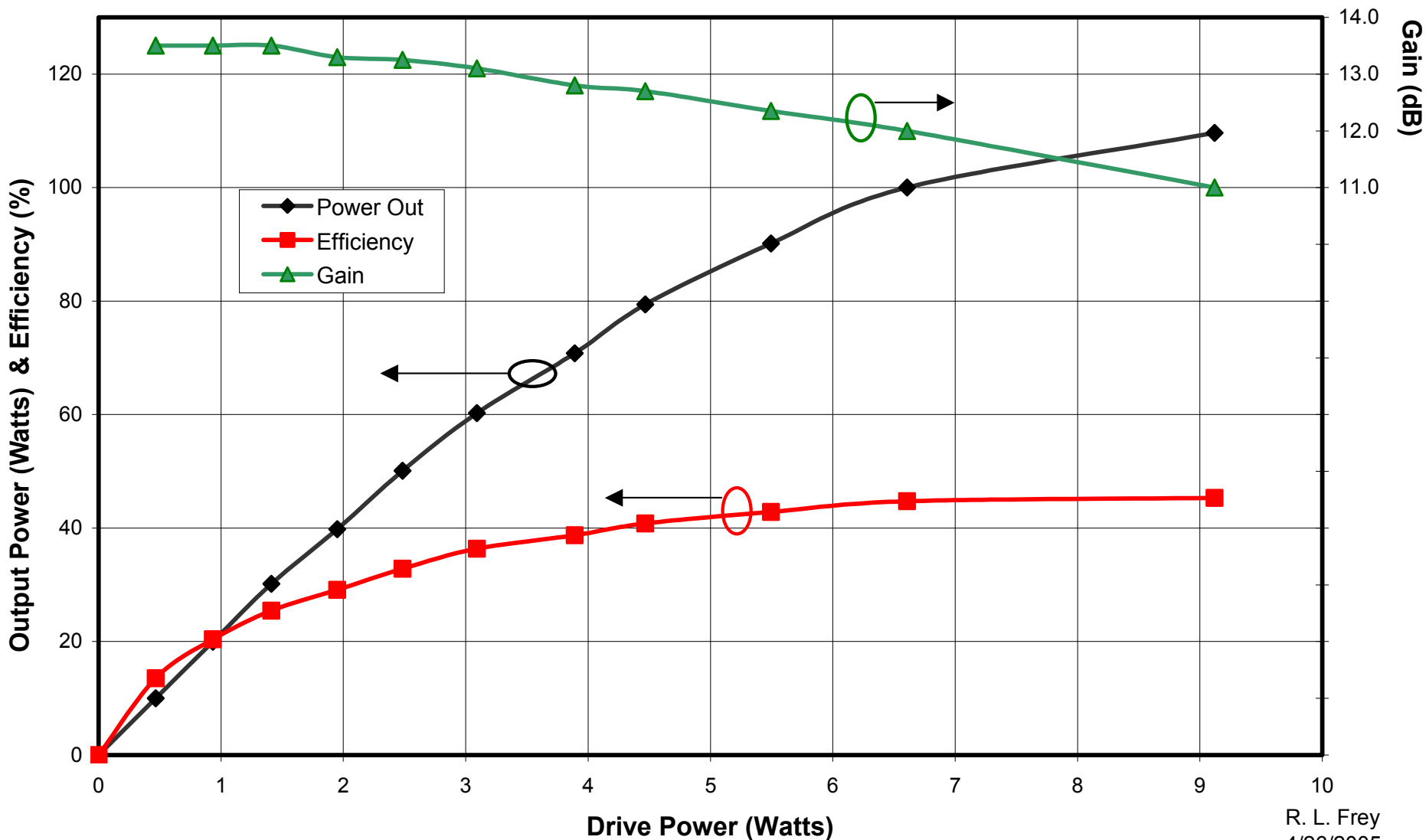
Eastern VHF Conf. 4/2006

AML Amp Operating on Original Frequency of 1975 MHz





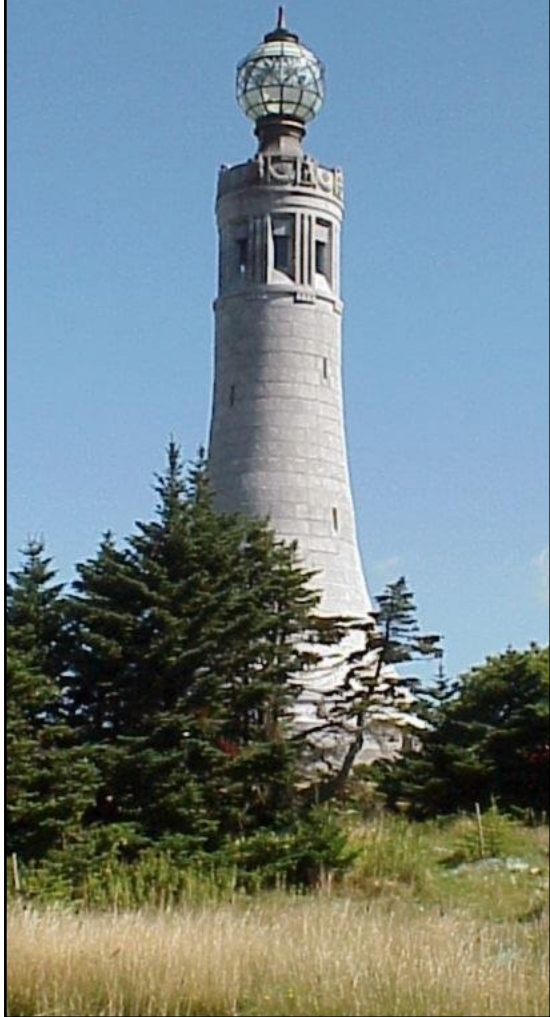
Copper Coaxial Cable Connections To Test Single Transistor



R. L. Frey
4/26/2005

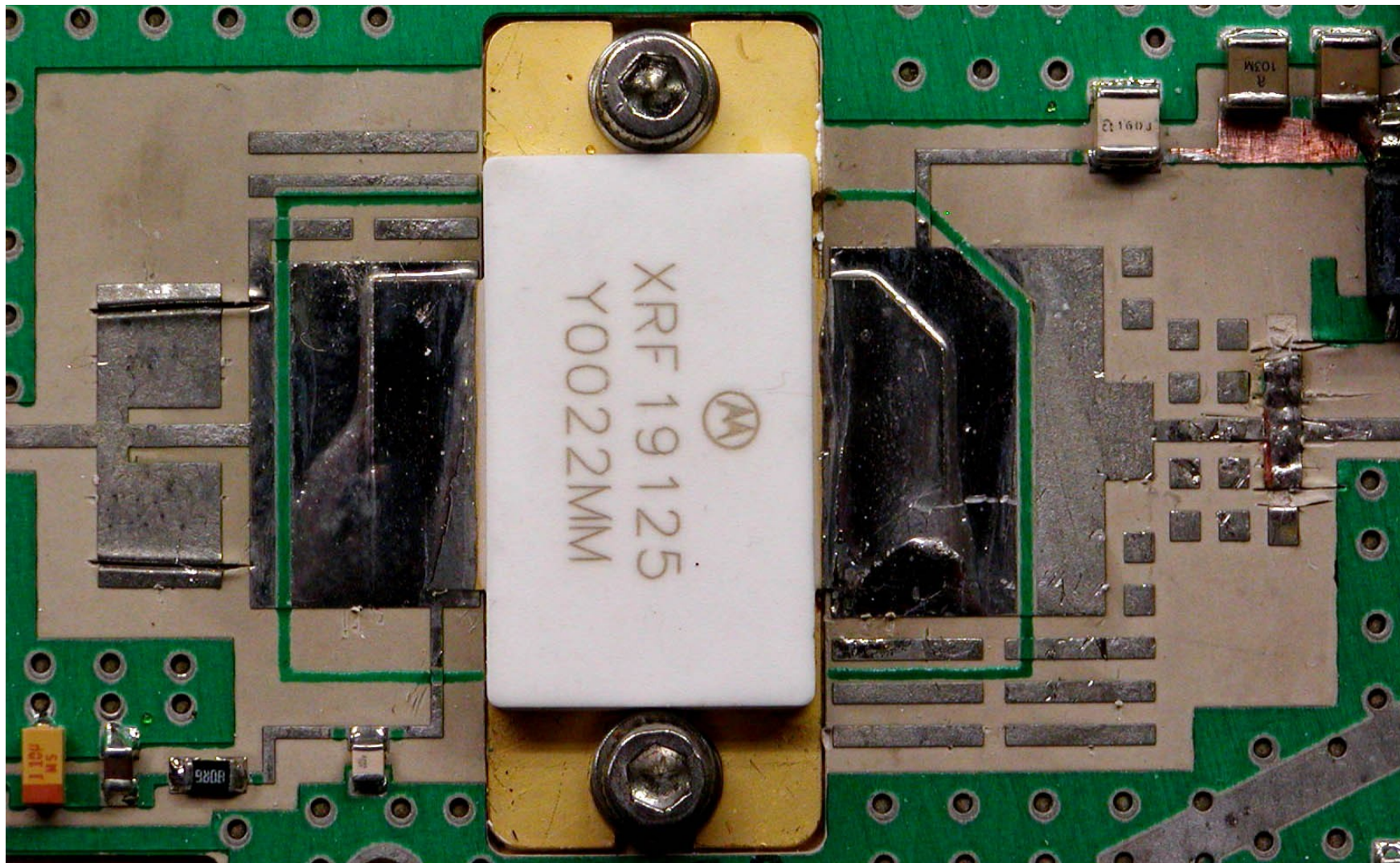
Top Transistor of AML Amplifier Operating on Original Frequency of 1975 MHz

W2SZ/1 (The MGEF)



AML Amplifier Performance at Original Freq. (1 Transistor)

- Power Output = 100 Watts
- Drive Power = 6.61 Watts
- Power Gain = 12.0 dB
- Input Return Loss = 6.9 dB **pew!**
- Power Supply = 26.3 Volts
- Current Draw = 8.5 Amps
- Efficiency = 44.7% ...

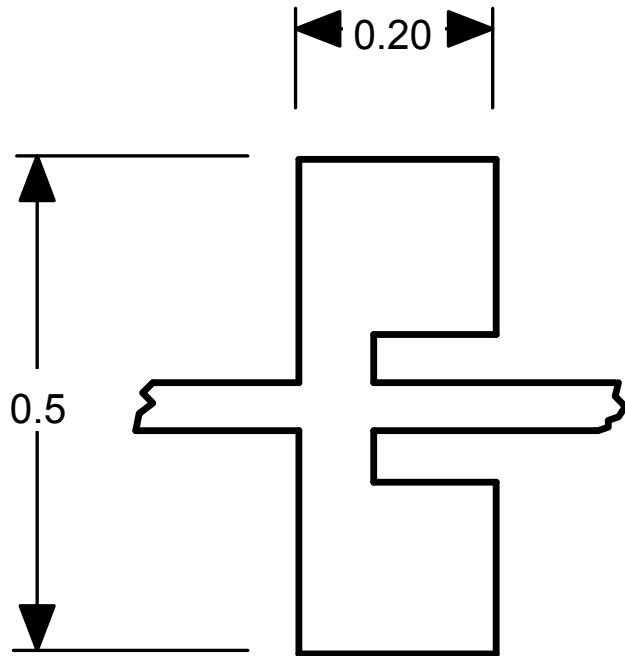


Original Input and Output Matching of Power Transistor

Input Microstrip Matching Network

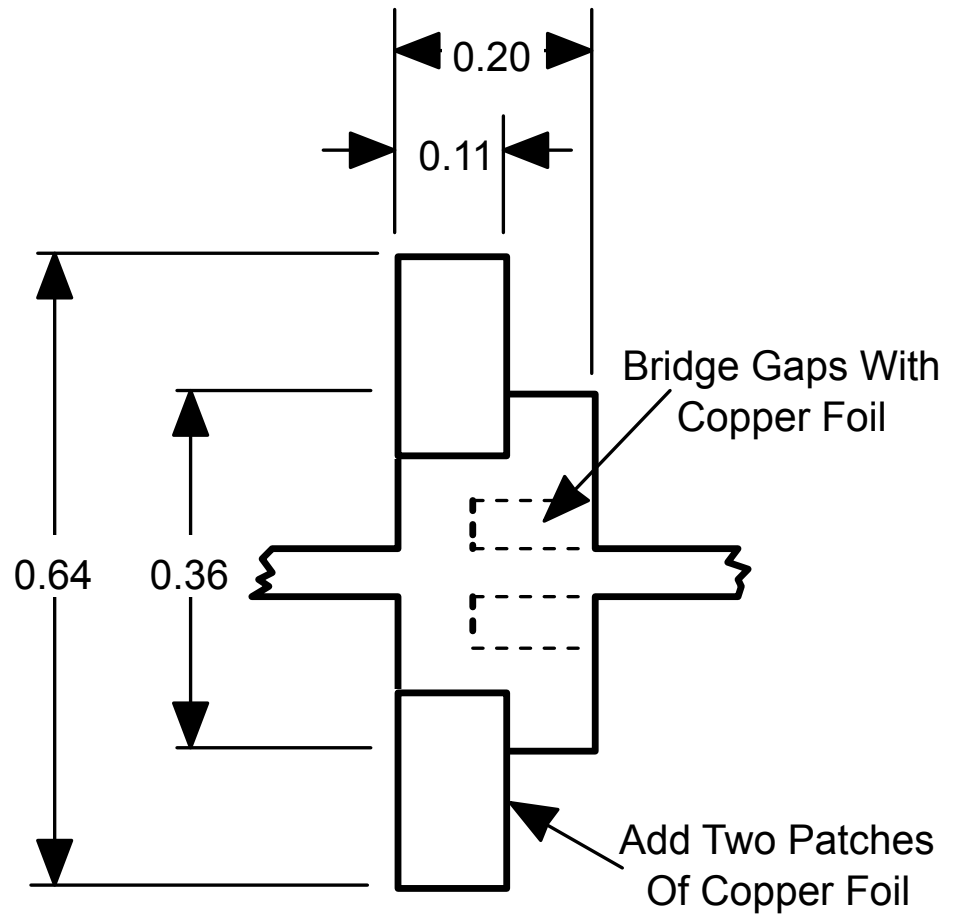
R. L. Frey
3/1/2006

(Second Pad Back From Power Transistor)



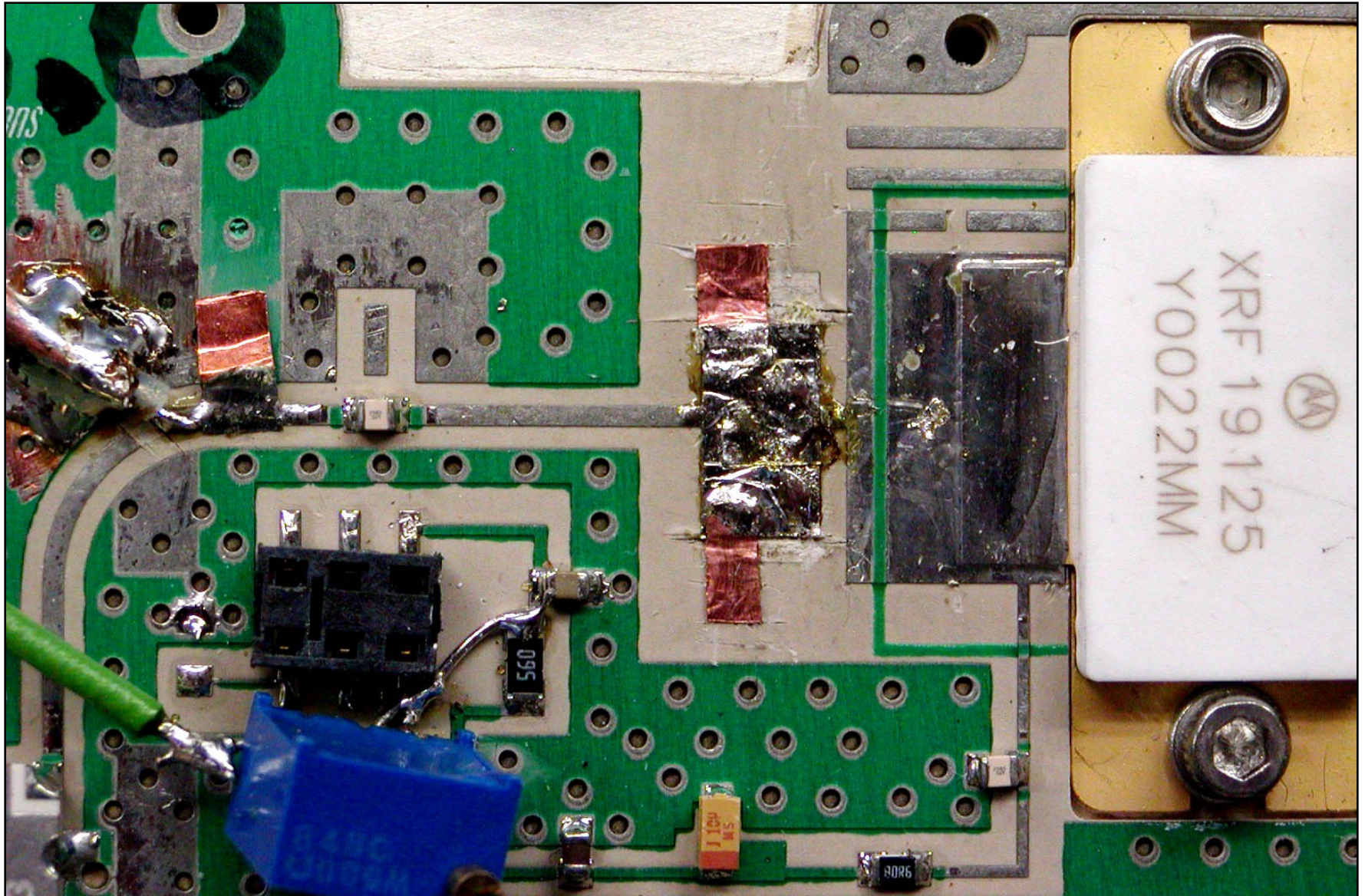
Original Design

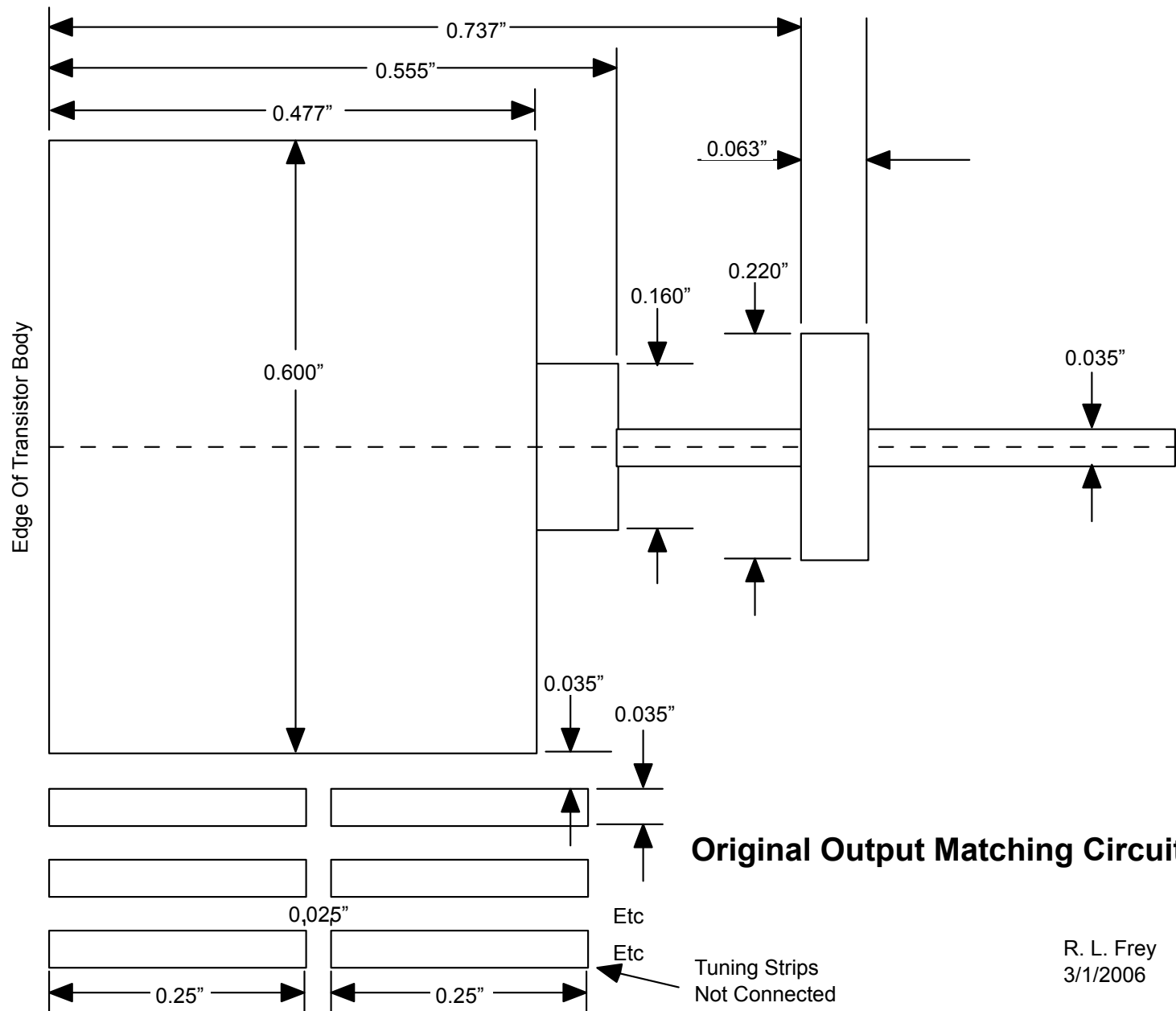
All Dimensions are in Inches



Modified for 2304 MHz

Input Match Modified For 2304 MHz





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3/1/2006

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3/1/2006

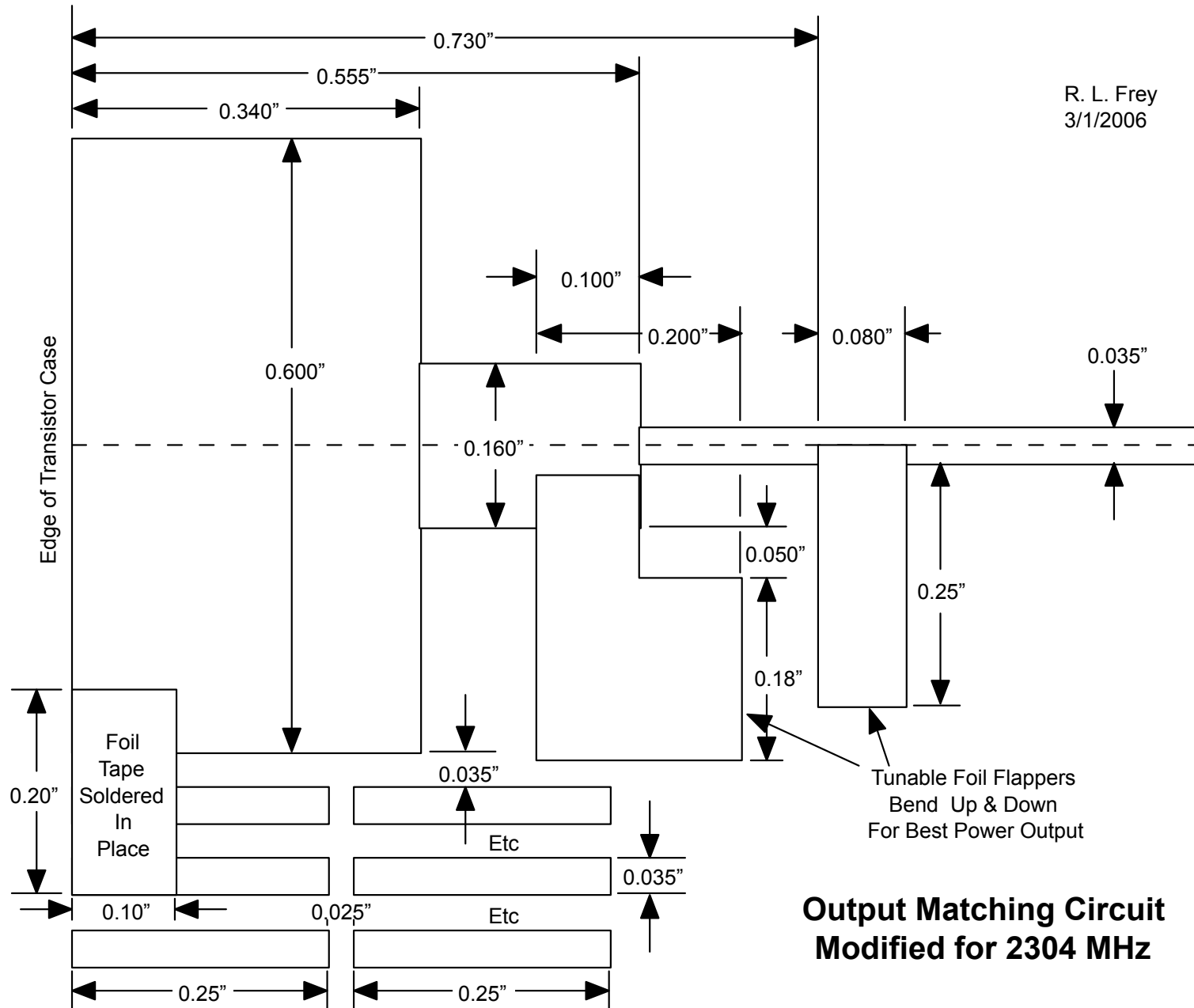
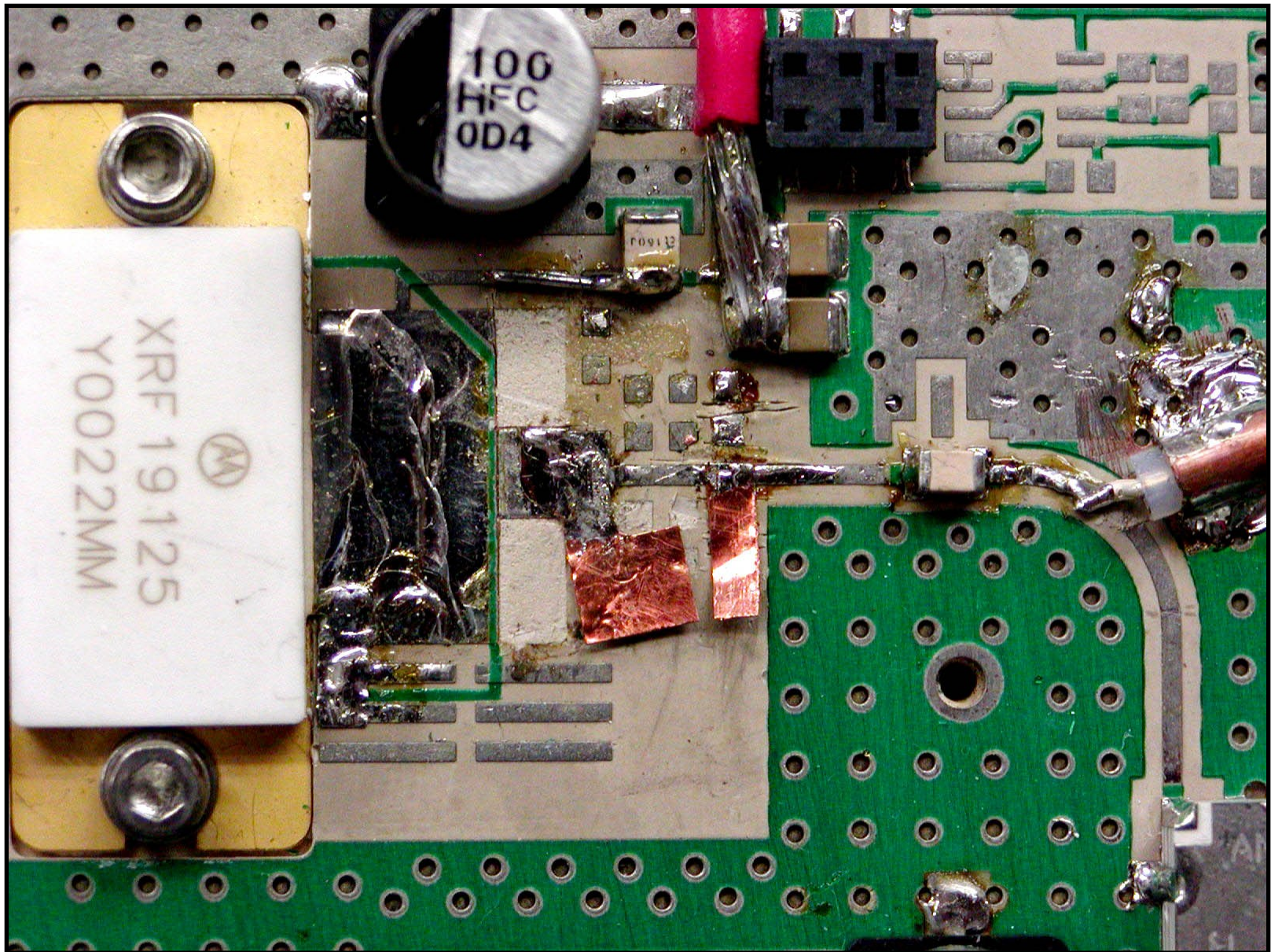
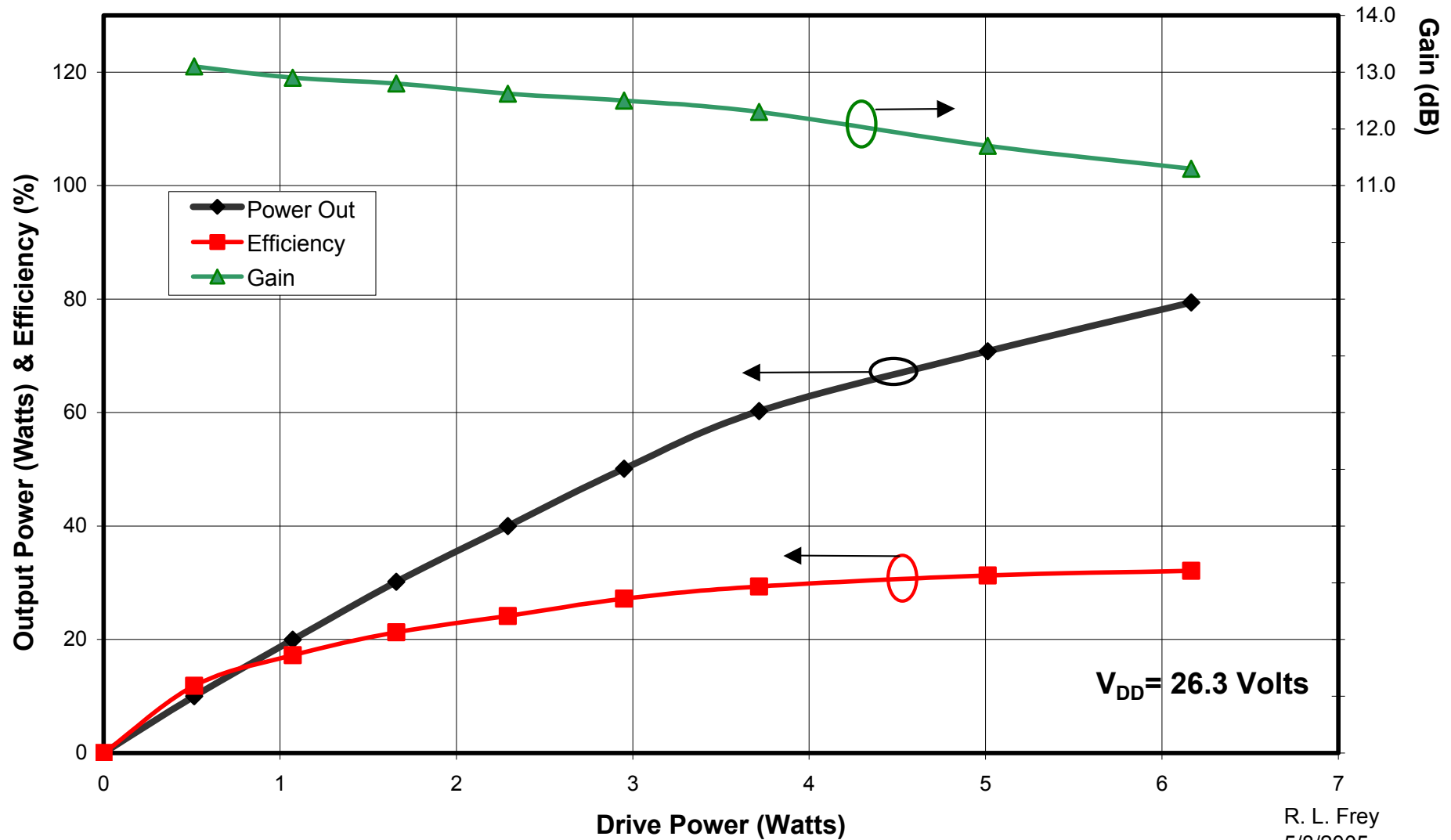


Photo of Output Matching Circuit Modified for 2304 MHz

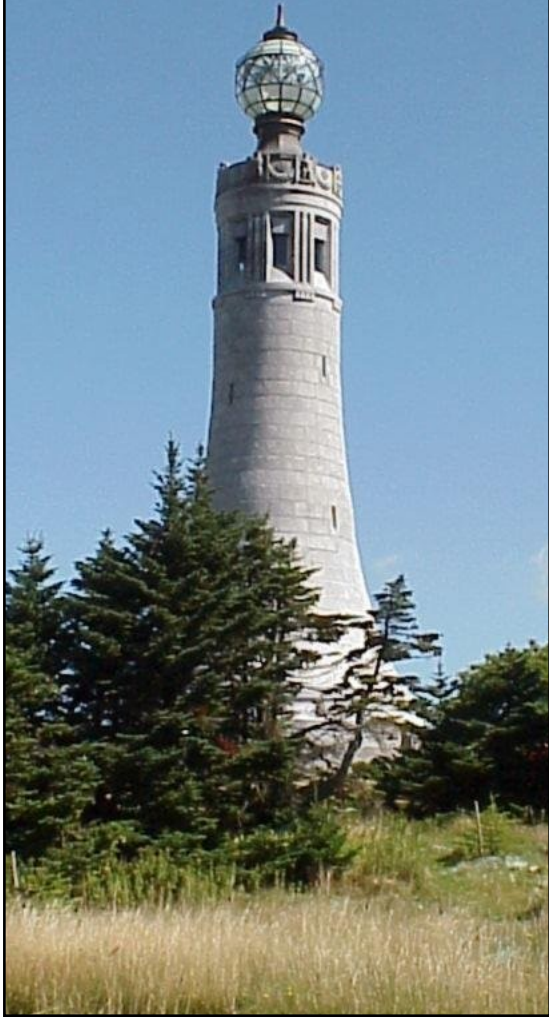


Top Transistor of AML Amplifier Retuned to 2304 MHz



R. L. Frey
5/8/2005

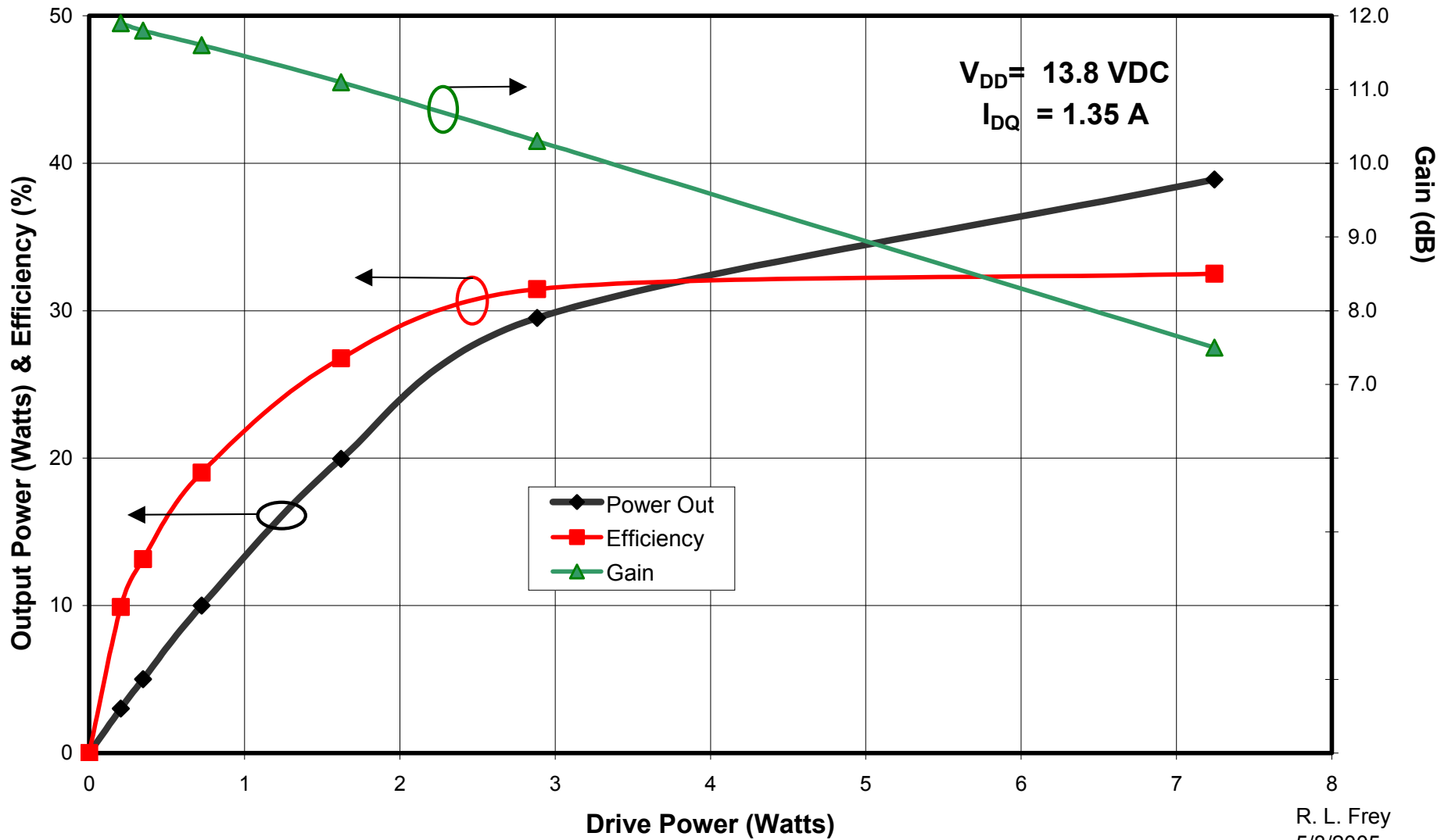
W2SZ/1 (The MGEF)



Performance at 2304 MHz

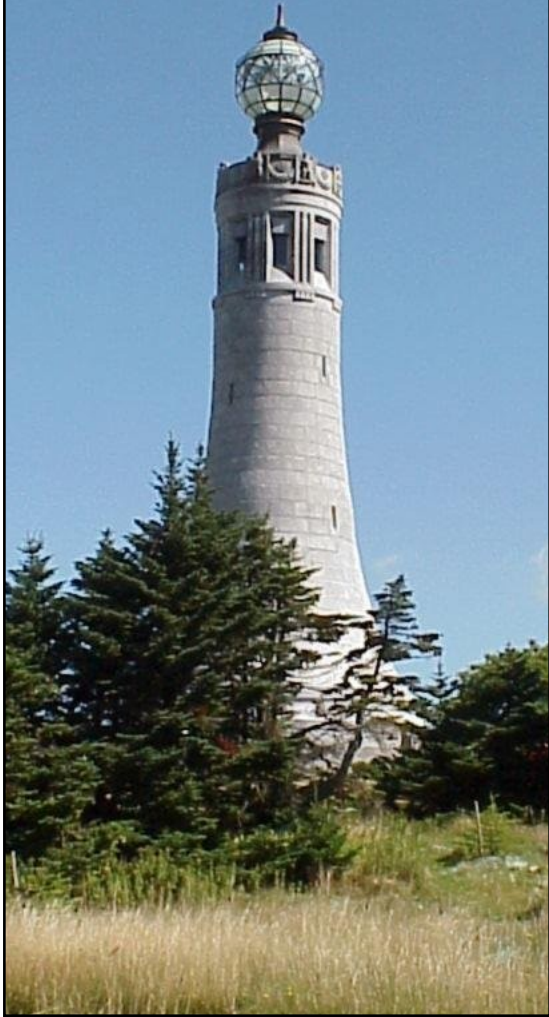
- Power Output = 79 Watts
- Drive Power = 6.2 Watts
- Power Gain = 11.3 dB
- Input Return Loss = 21.4 dB
- Power Supply = 26.3 Volts
- Current Draw = 9.4 Amps
- Efficiency = 32% ... - Not Great
But We Do Have 79 Watts!

Top Transistor of AML Amplifier Retuned to 2304 MHz



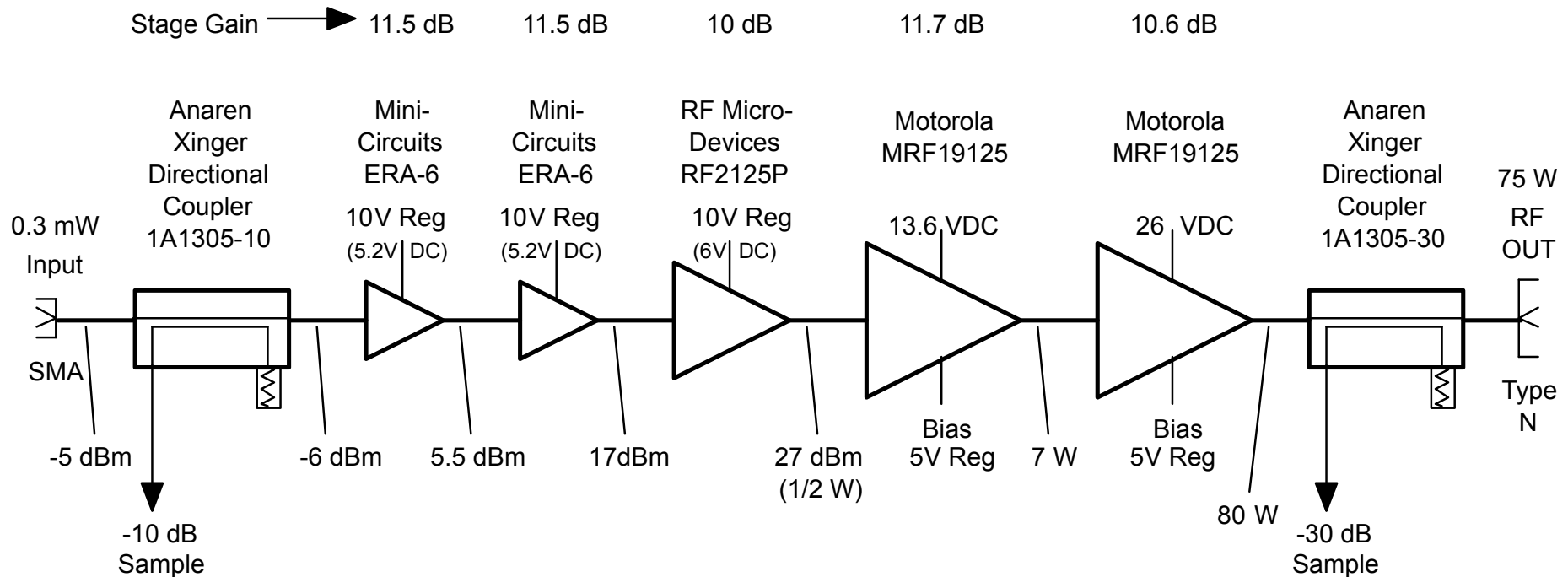
R. L. Frey
5/8/2005

**W2SZ/1
(The MGEF)**



Performance at 2304 MHz With $V_{DD} = 13.8$ Volts DC

- Power Output = 20 Watts
- Drive Power = 1.62 Watts
- Power Gain = 11.1 dB
- Input Return Loss = 19.7 dB
- Power Supply = 13.8 Volts
- Current Draw = 5.4 Amps
- Efficiency = 27% ... - Poor, But
We Do Have 20-30 W. at 13.8 V
And it is a 26-Volt Transistor!!

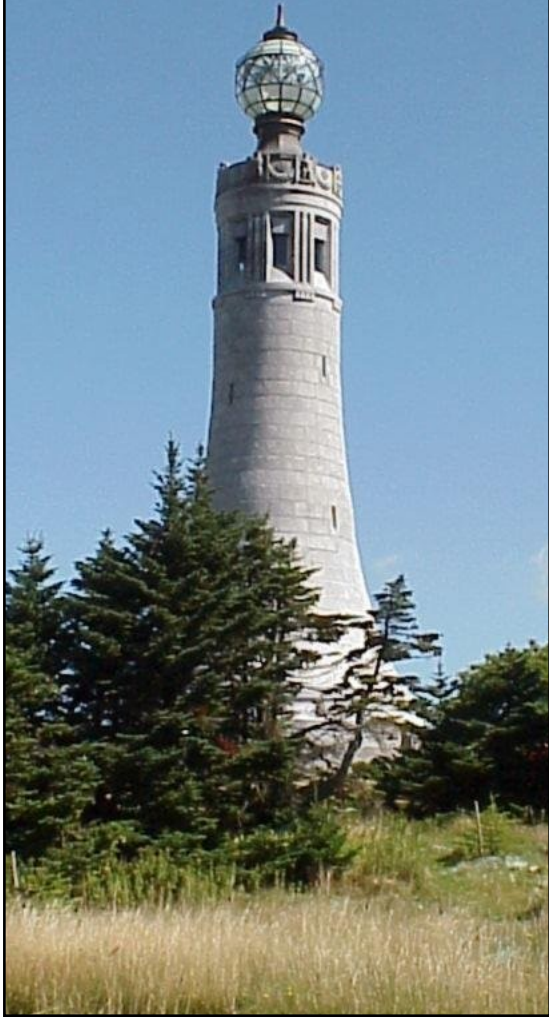


AML PCS Power Amplifier On 2304 MHz

Model No. S80PCSA Part No. 1000103P1 Rev. 4

RLF
3/2/2006
HiGain1.cdd

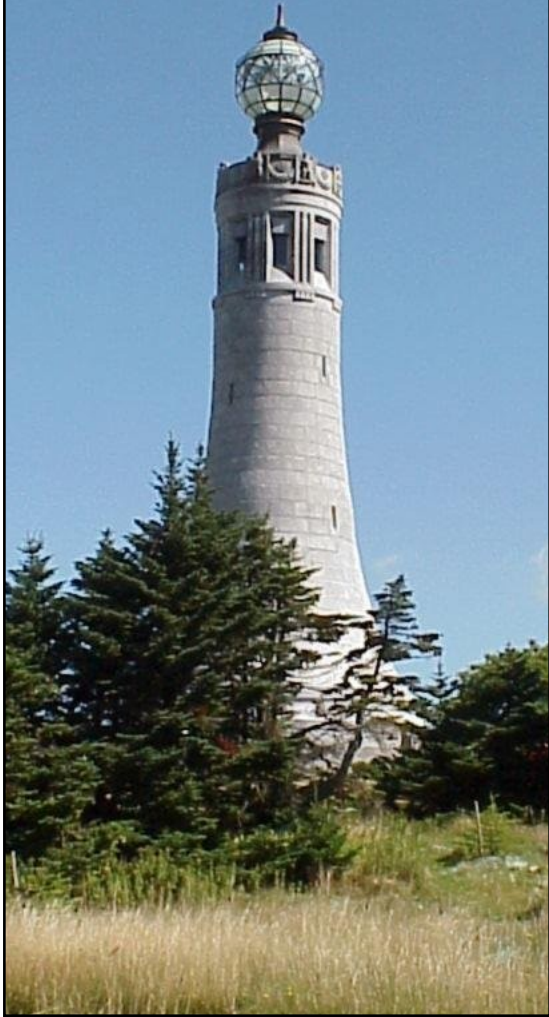
W2SZ/1 (The MGEF)



Predicted Performance of the Suggested Cascade of Stages

- Power Output = 70-80 Watts
- Drive Power $\sim\sim$ 0.3 Milliwatts
- Power Gain > 50 dB **watch out**
- Power Supply = 26.3 V @ 9.4 A
And 13.8 V at about 5 amps

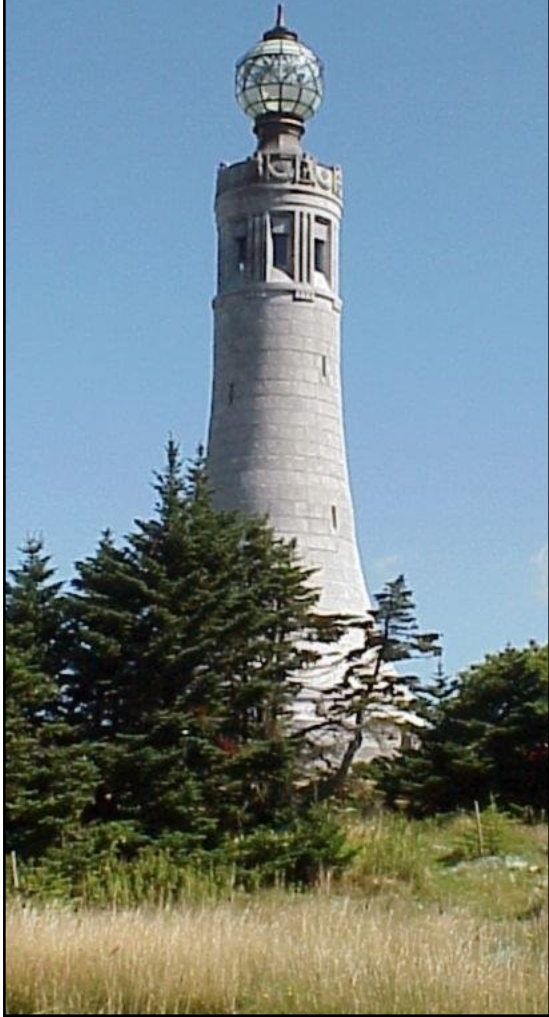
W2SZ/1 (The MGEF)



Conclusions

- Very Useful Building Block
- Requires Some Work to Use It
- Efficiency Only Fair, but Typical
- Absolutely Needs Big Heatsink!!
- Will Deliver 25-30 W at 13.8 V
- Low Level Driver Design Still Needed
- **My First Try on 1296 MHz →
Did **NOT** Work**

W2SZ/1 (The MGEF)



More Information At:

- Detailed information in living color is available at:

<http://www.mgef.org/amps/index.html>

And

http://www.walhco.net/PCS_index.html

- To Obtain an Amplifier Contact
R. L Frey – WA2AAU at E-mail:
rlf2gpa@localnet.com