EVLA Front-End CDR

Octave Bandwidth OMT Development in the 1-8 GHz Range

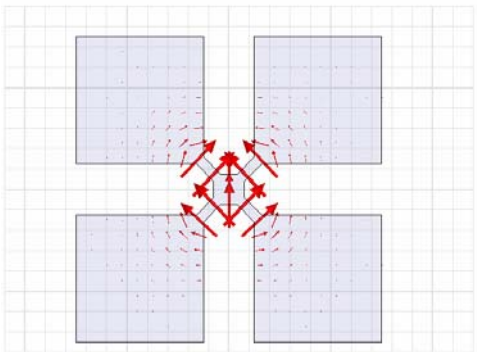
Frequency Ranges

• L:	1- 2 GHz	2:1	(“Octave”)
• S:	2 – 4 GHz	2:1	(“Octave”)
• C:	4 – 8 GHz	2:1	(“Octave”)
• X:	8 – 12 GHz	1.5:1	
• Ku:	12 – 18 GHz	1.5:1	
• K:	18 – 26 GHz	1.44:1	
• Ka:	26 – 40 GHz	1.54:1	
• Q:	40 – 50 GHz	1.25:1	

Why Quad-Ridge?

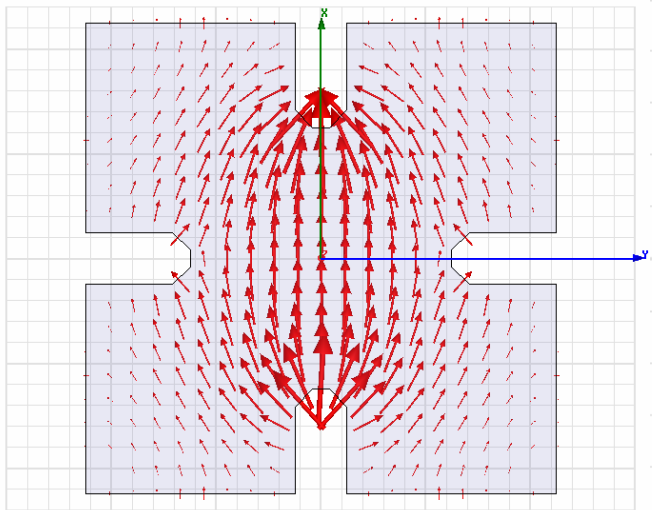
- Septum, Boifot types ~ 1.5:1 maximum
- cf. Q-R horns 2-18 GHz
- Low impedance structure

“Good” Mode

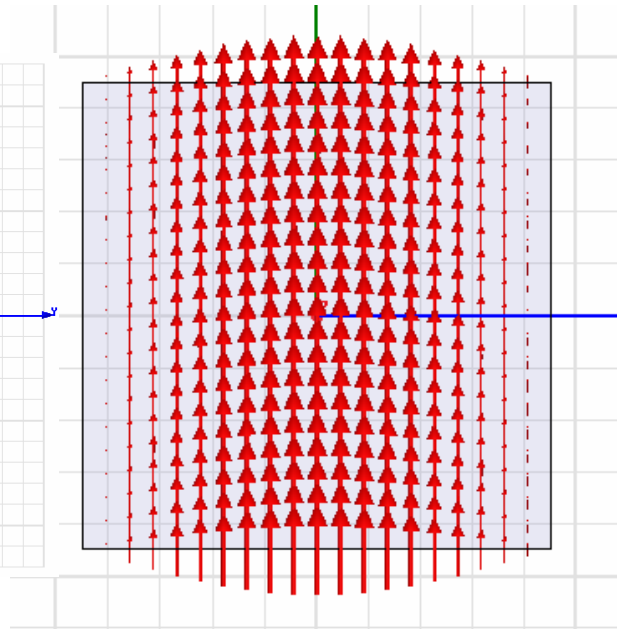


fco = 0.68

“Z” ~ 50 Ω



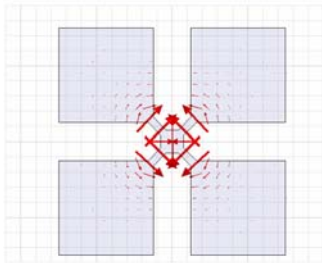
fco = .74



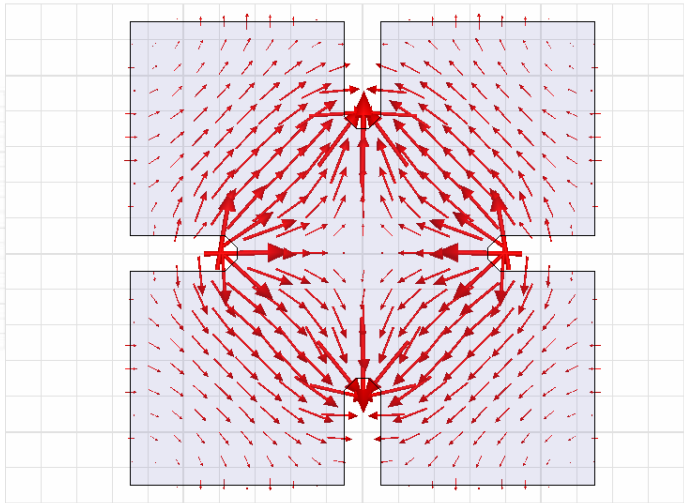
fco = .91

“Z” ~ 500Ω

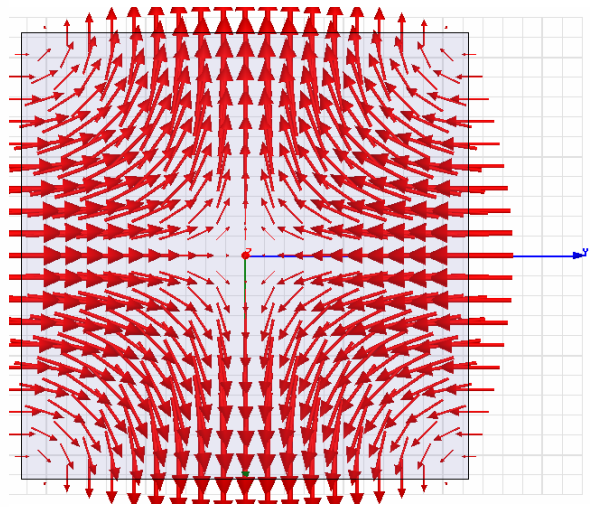
“Bad Mode”



fco = .69

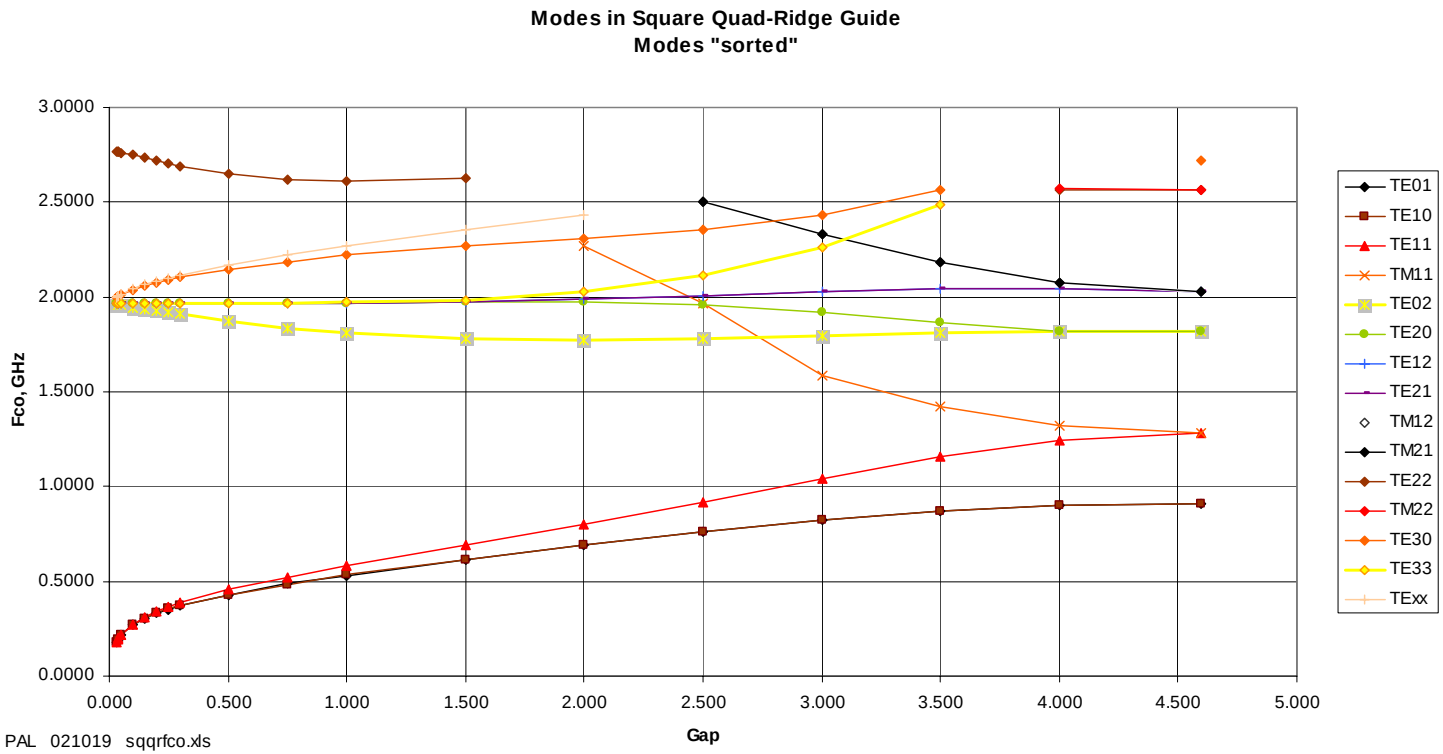


fco = .88

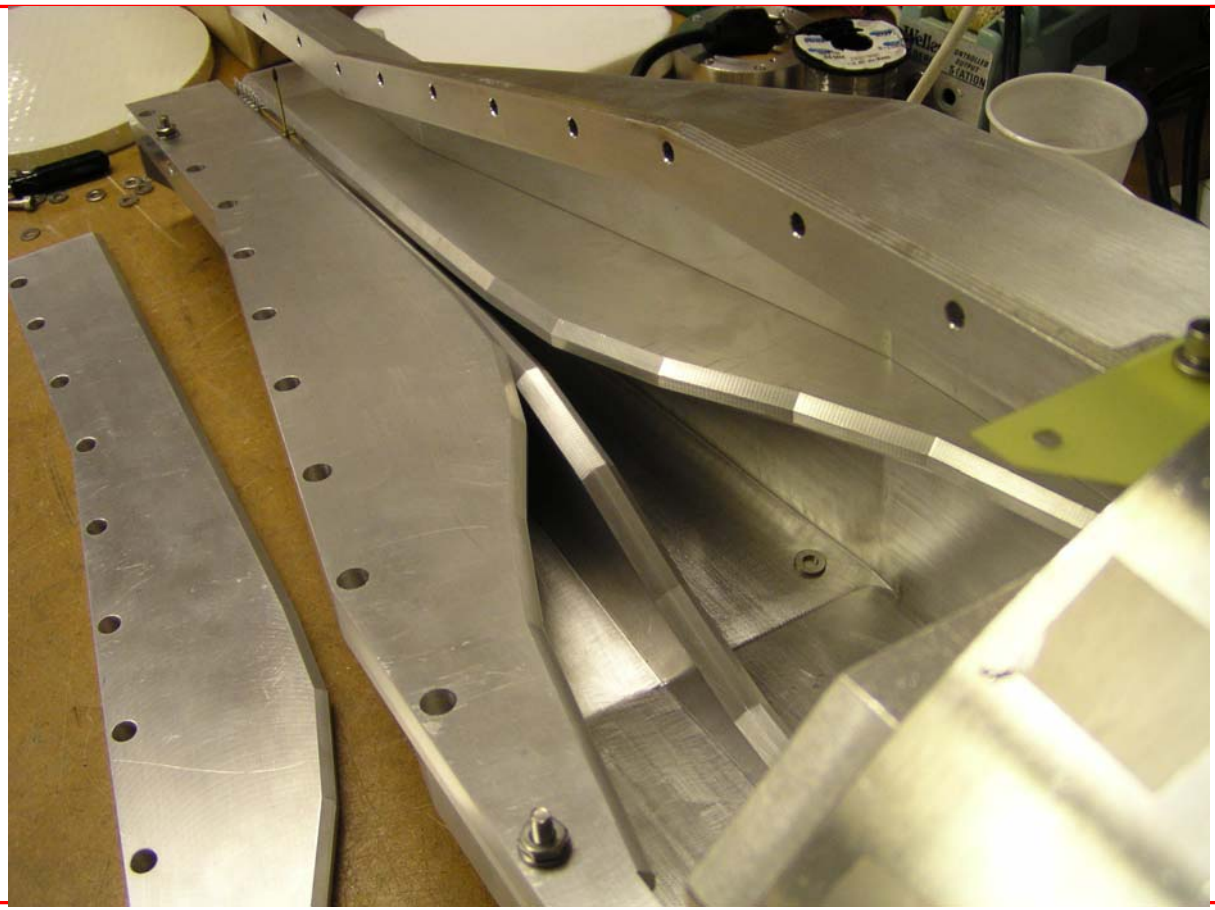


fco = 1.28

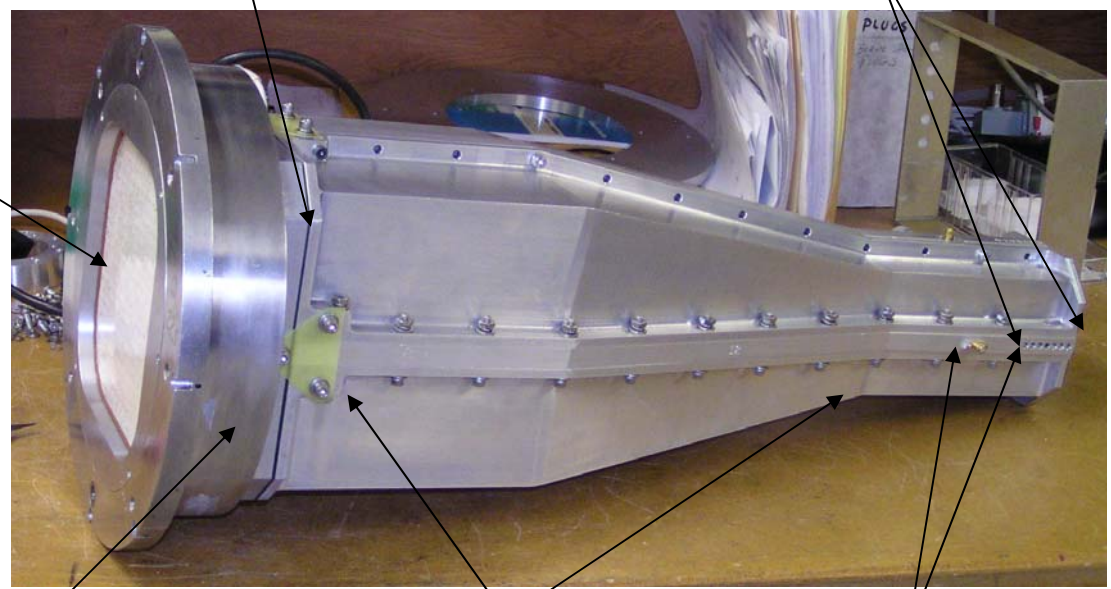
fco *vs.* distance



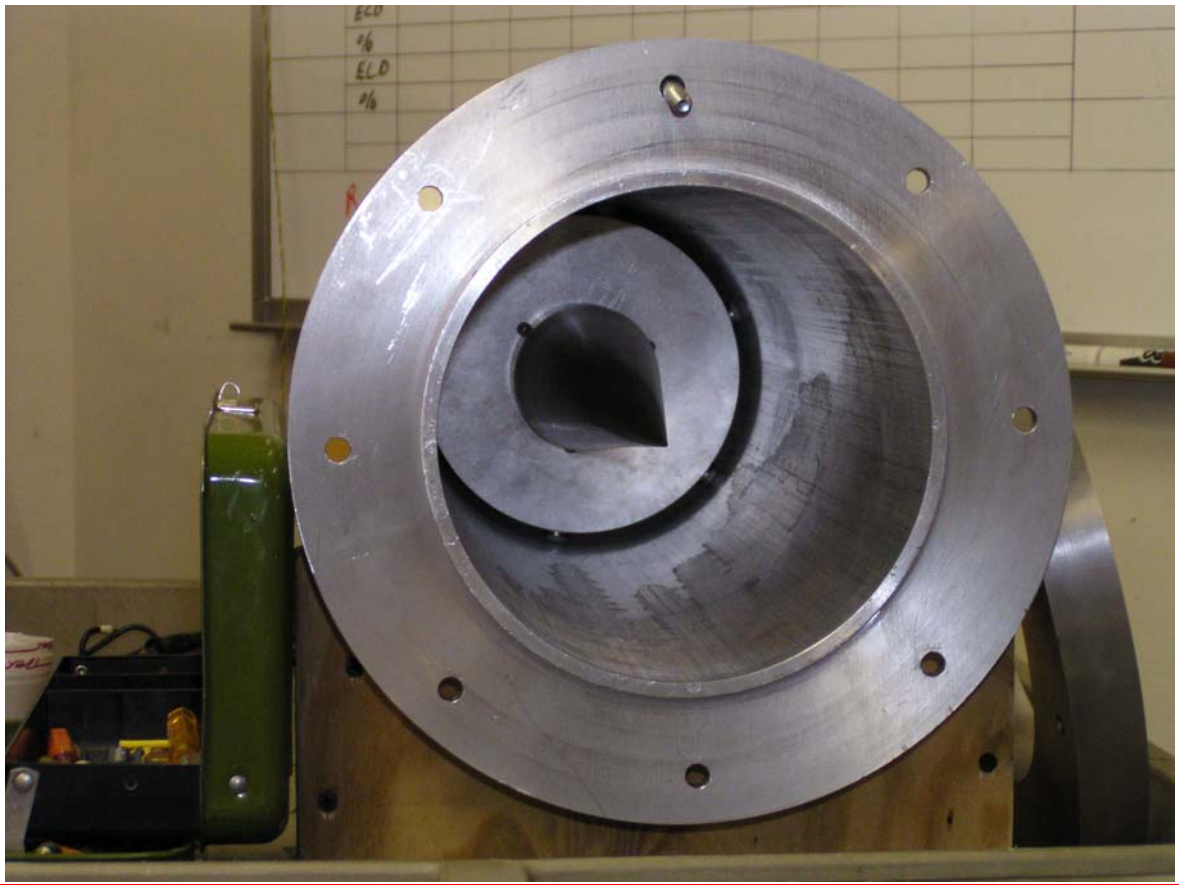
Quad-Ridge



OMT Components

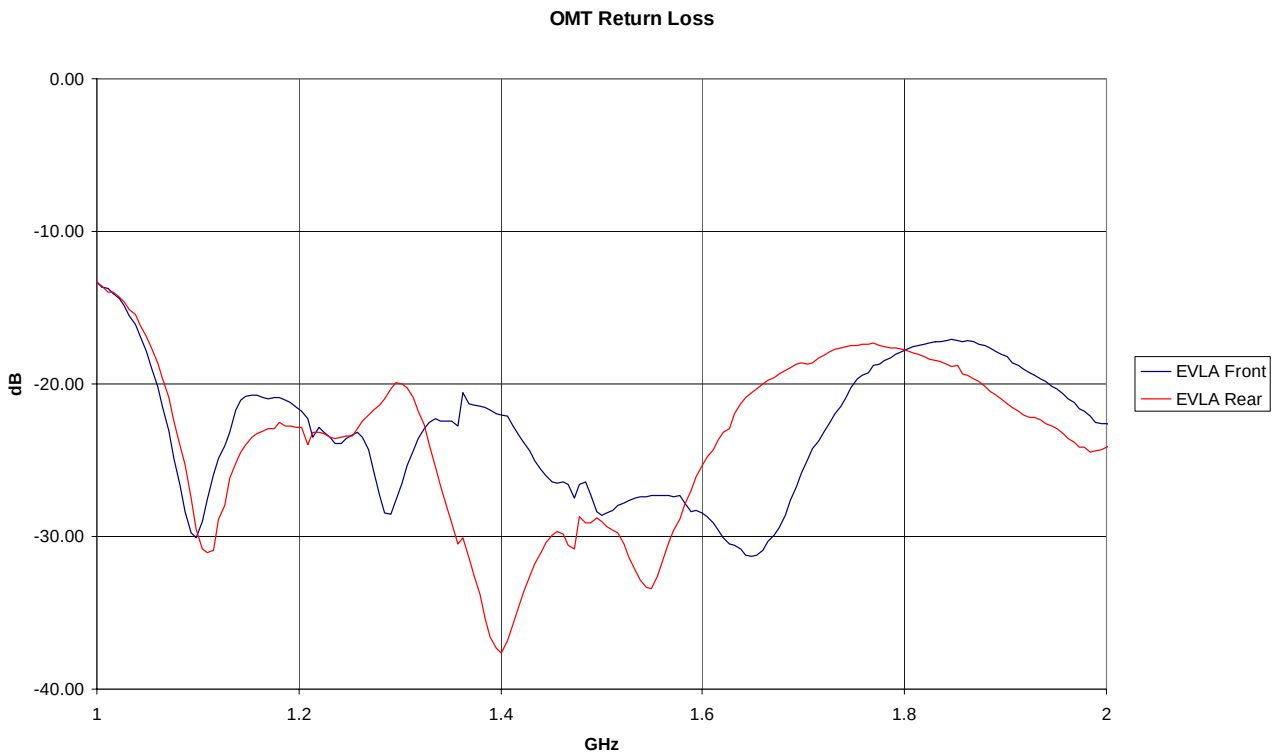


Sliding Load

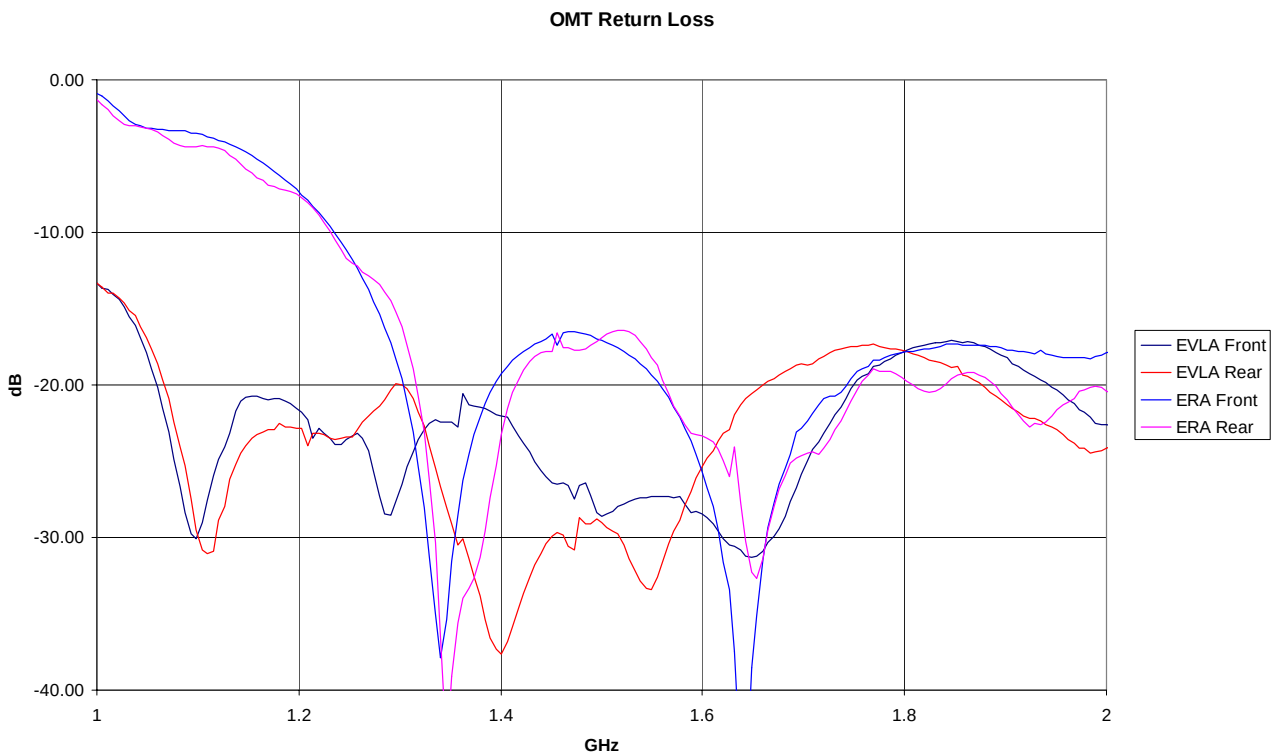



04.10.2006

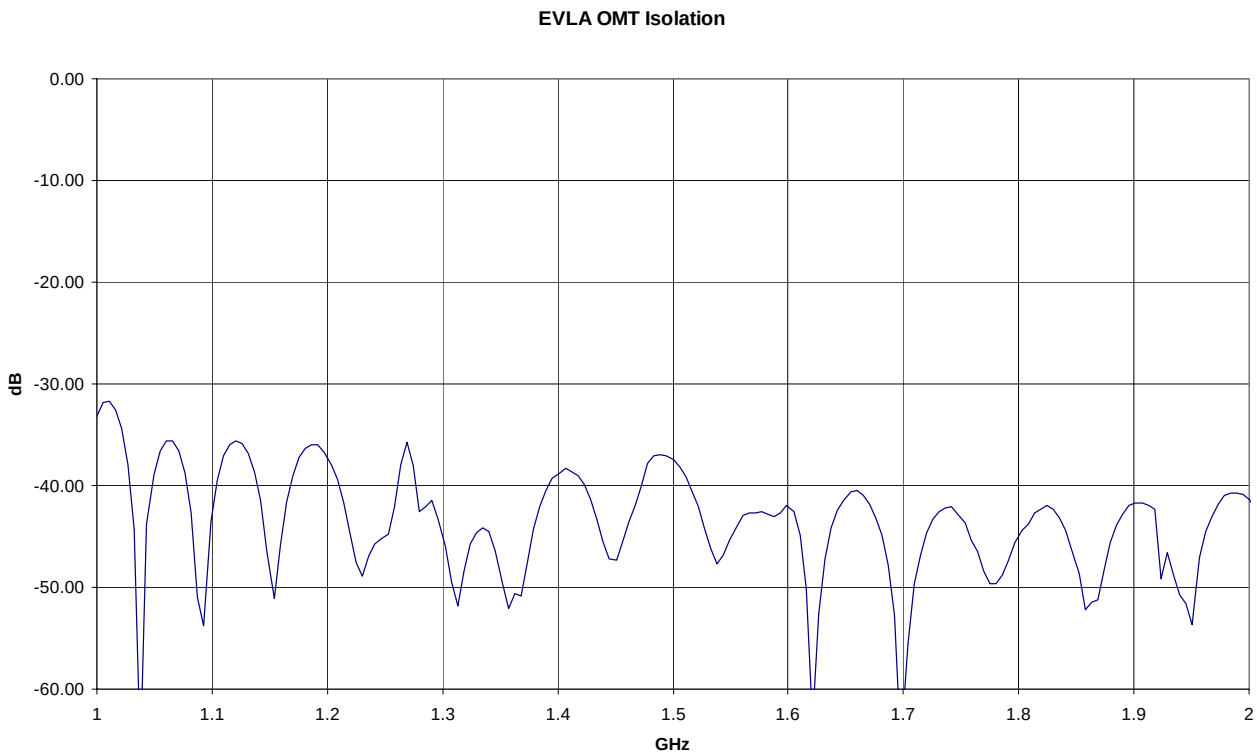
Return Loss


OMT Return Loss
0.00
-10.00
-20.00
-30.00
-40.00
dB
1
1.2
1.4
1.6
1.8
2
GHz
EVLA Front
EVLA Rear

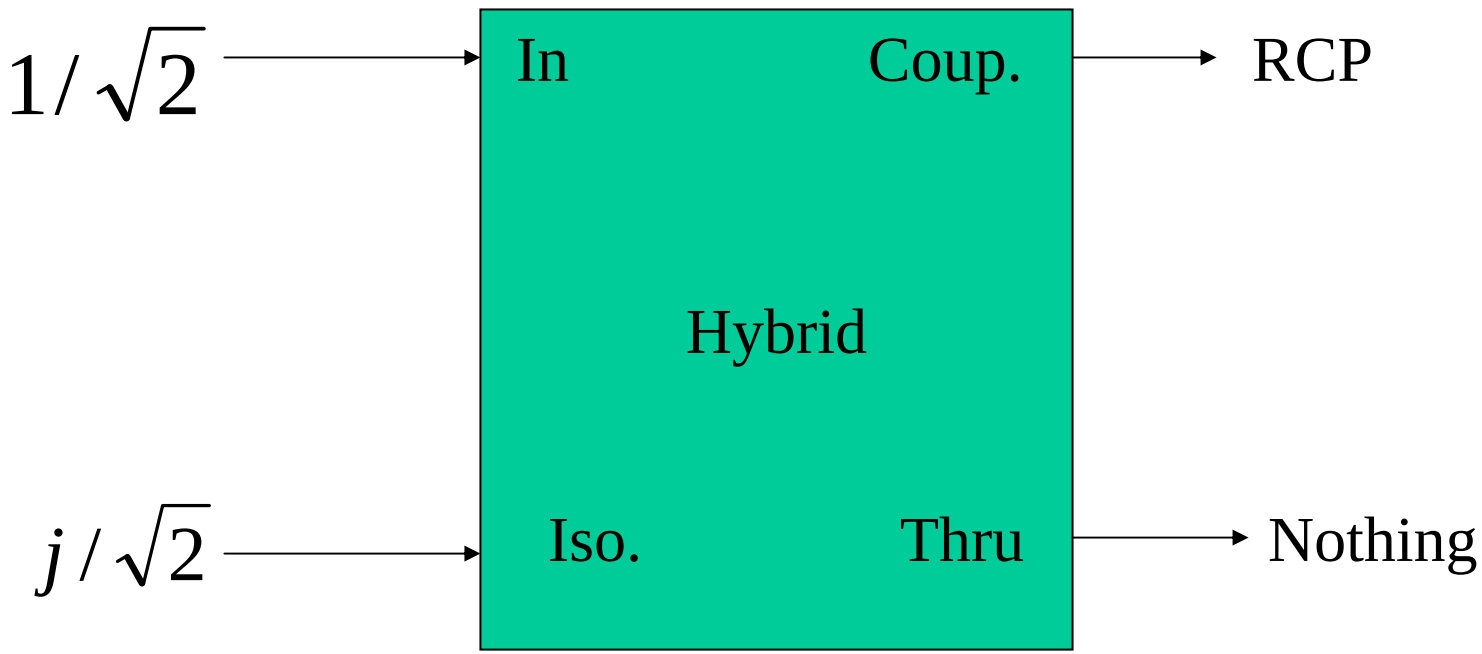
vs. ERA OMT


OMT Return Loss
0.00
-10.00
-20.00
-30.00
-40.00
dB
1
1.2
1.4
1.6
1.8
2
GHz
EVLA Front
EVLA Rear
ERA Front
ERA Rear

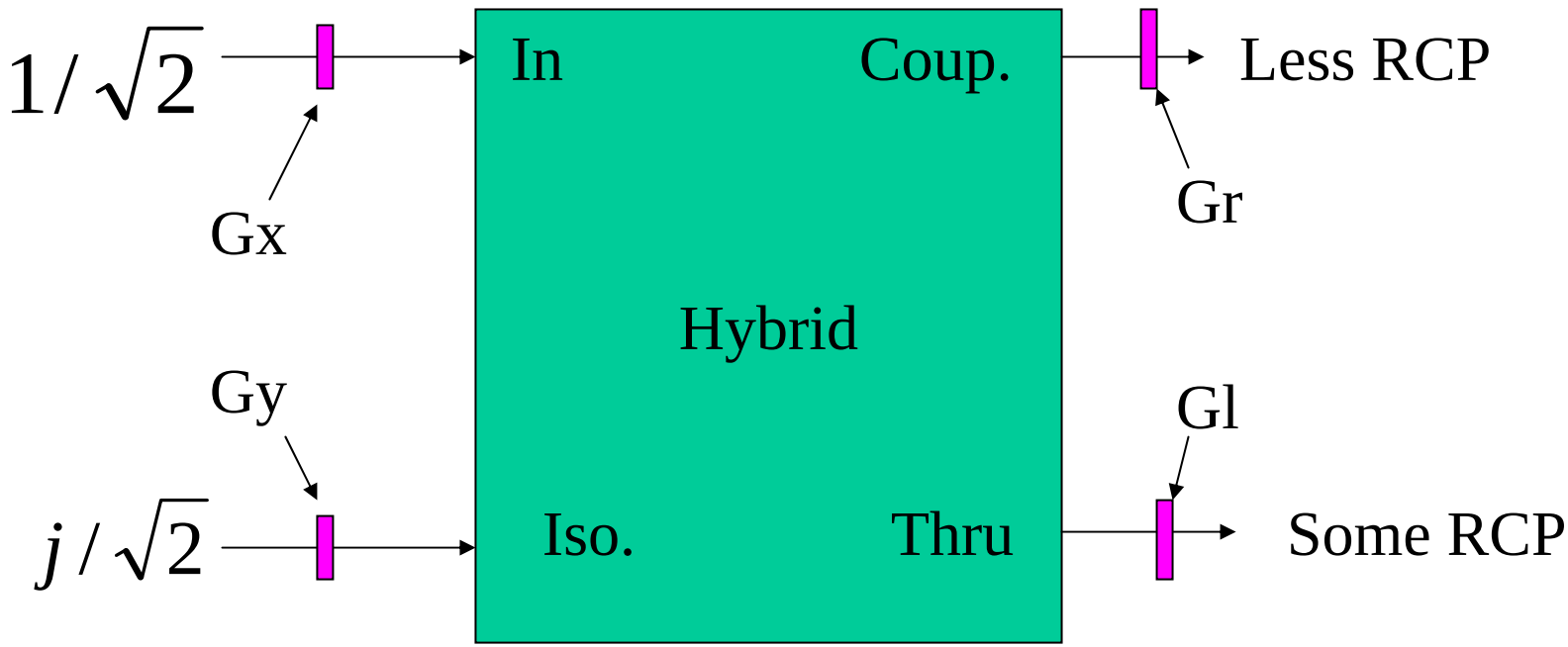
Isolation


EVLA OMT Isolation
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
dB
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
GHz

90-degree hybrid



Mis-matched 90-degree hybrid



Math

$$A \equiv kSin\theta \quad B \equiv \sqrt{1-k^2}$$

With pure RCP input,

$$R = \frac{j}{d\sqrt{2}}(A + B + \beta G_R(BG_Y - BG_X)) \text{ and}$$

$$\frac{L}{R} = j\frac{A - B + \beta G_L(BG_R + AG_Y)}{A + B + \beta G_L(AG_X - BG_Y)}$$

Axial Ratio (Amplitudes;Voltages)

$$\alpha = \frac{\rho + 1}{\rho - 1} \quad \text{where} \quad \rho \equiv \frac{|L|}{|R|}$$

$$\text{for } \alpha \text{ "} < 1\,\text{dB"}, \ \alpha < 1.122 \Rightarrow \rho < .0575$$

For $\alpha < 1$ dB

- (With some assumptions) we can specify that the return losses of a pair of ports must sum to better than ~34 dB
- This sort of tradeoff applies to any polarizer.
- With perfect amplitude & phase, the sum would be ~25 dB.

Next to do

- Reduce mass of OMT.
- Improve Cooling.
- Better window material.
- Investigate manufacturability.

Conclusions

- Prototypes have been built
- Return loss is acceptable across band
- Isolation is good across band
- “Suck-out” suppression is effective