

Use of WR28 Waveguide on 47 GHz?



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Use of WR28 Waveguide on 47 GHz?

- Why the Use of WR28 is Significant
- Technical Specifications
- Problems Anticipated
- Test Results
- Recommendations



Significance of WR28 Use on 47 GHz?

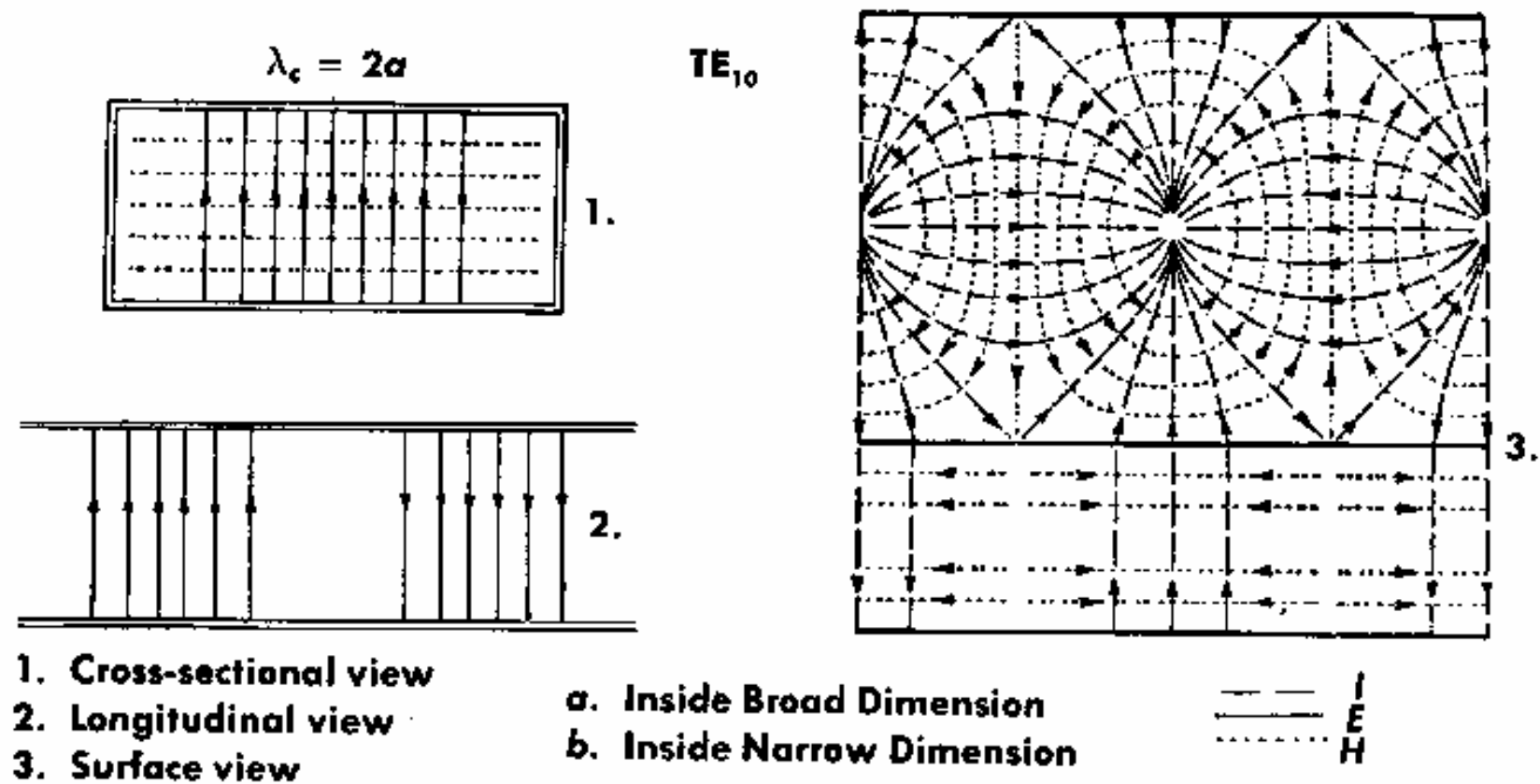
- WR28 is Intended for 26-40 GHz Use
- Readily Available on Surplus Market at Good Prices
- WR22 and WR19 Pieces are Rare and Expensive
- Round & Square Flanges Interconnect with WR22 Waveguide Flanges



Problems Anticipated With WR28

- The dominant TE_{10} propagation mode is dependent on Width of Waveguide
- Tendency to Go Into Higher Modes (TE_{xx} , etc) with Higher Frequency & Discontinuities in Waveguide
- Expect problems With Bends, Twists, etc

Waveguide Propagation Modes

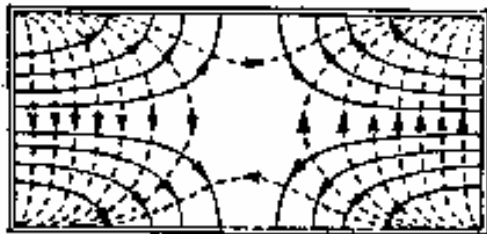


Cutoff Wavelength = 21.1 GHz

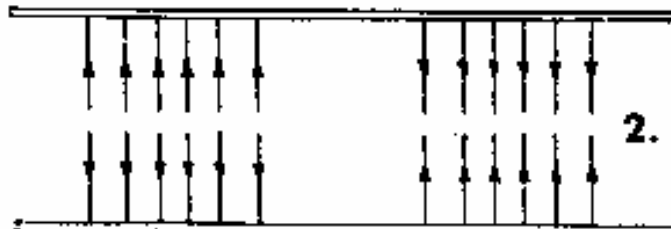
Waveguide Propagation Modes

$$\lambda_c = \frac{2a}{\sqrt{1 + (a/b)^2}}$$

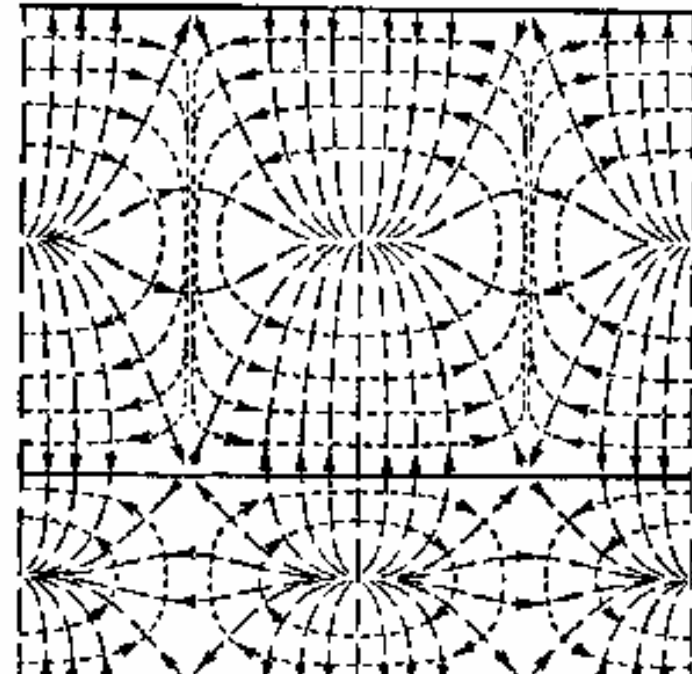
TE₁₁



1.



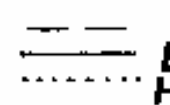
2.



3.

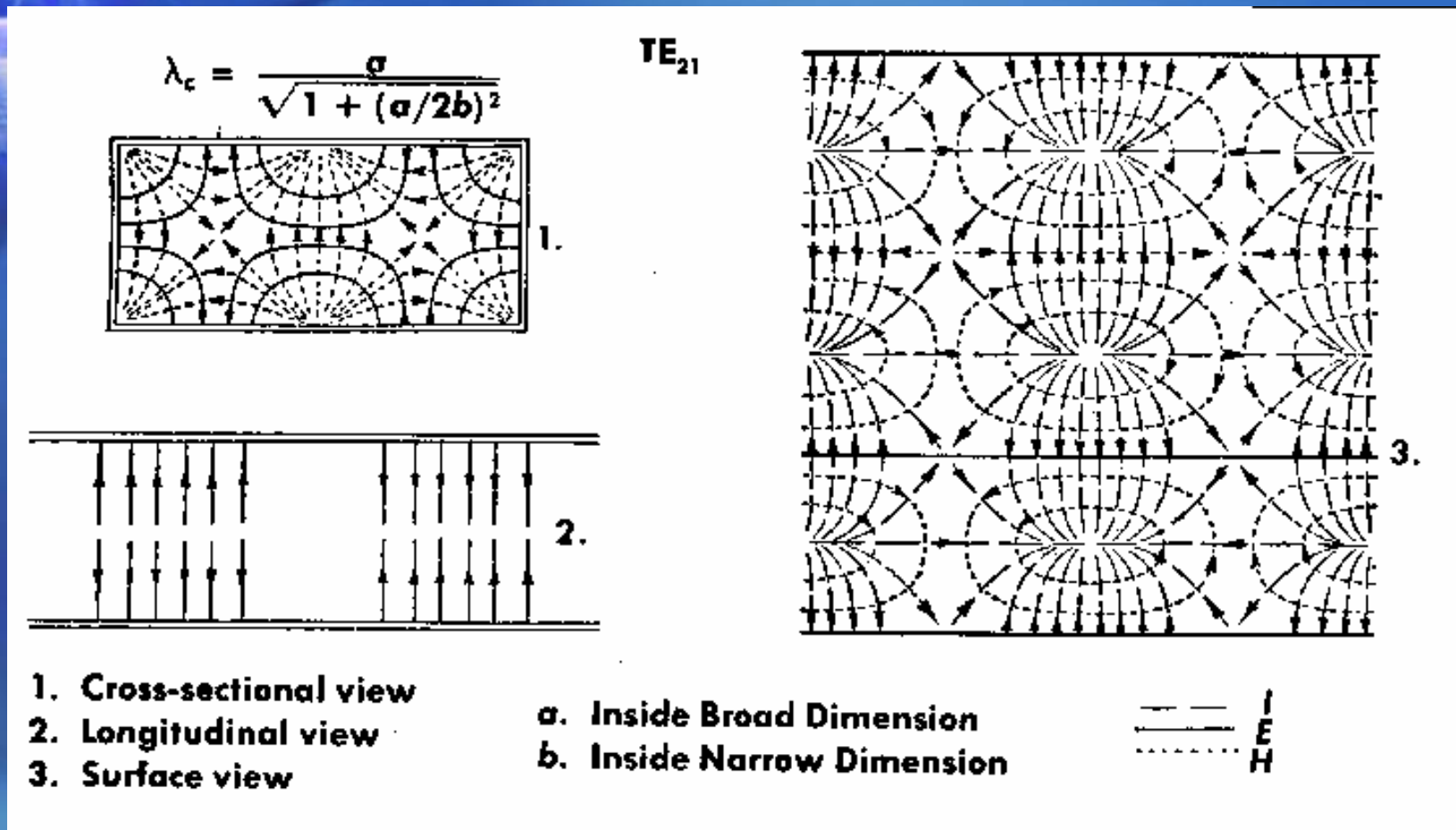
1. Cross-sectional view
2. Longitudinal view
3. Surface view

- a. Inside Broad Dimension
- b. Inside Narrow Dimension



Cutoff Wavelength = 47.2 GHz

Waveguide Propagation Modes



Cutoff Wavelength = 59.6 GHz



Measurement System & Tests

- Scalar Network Analyzer HP 8757A
- HP 82025 Q Band WG Detectors (WR22)
- HP 8697A-H50 Sweeper 33-50 GHz
- Baytron WR22 20 dB Broadwall Coupler
- Various Q Band Loads, Attenuators
- Test System in WR22 WG Round Flanges
- Commercial Round to Rectangular Adaptors
- Tests Conducted
 - Return Loss & Through Attenuation
 - 40 to 50 GHz

Test Results- “2 Inch” Straight WG



Test Results- “2 Inch” Straight WG

CH1: A -M S - 19.60 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .35 dB
1.0 dB/ REF - .00 dB

47 GHZ WR-28 TEST WAVELINE 2 INCH STRAIGHT

20 dB
RL

1 dB
IL

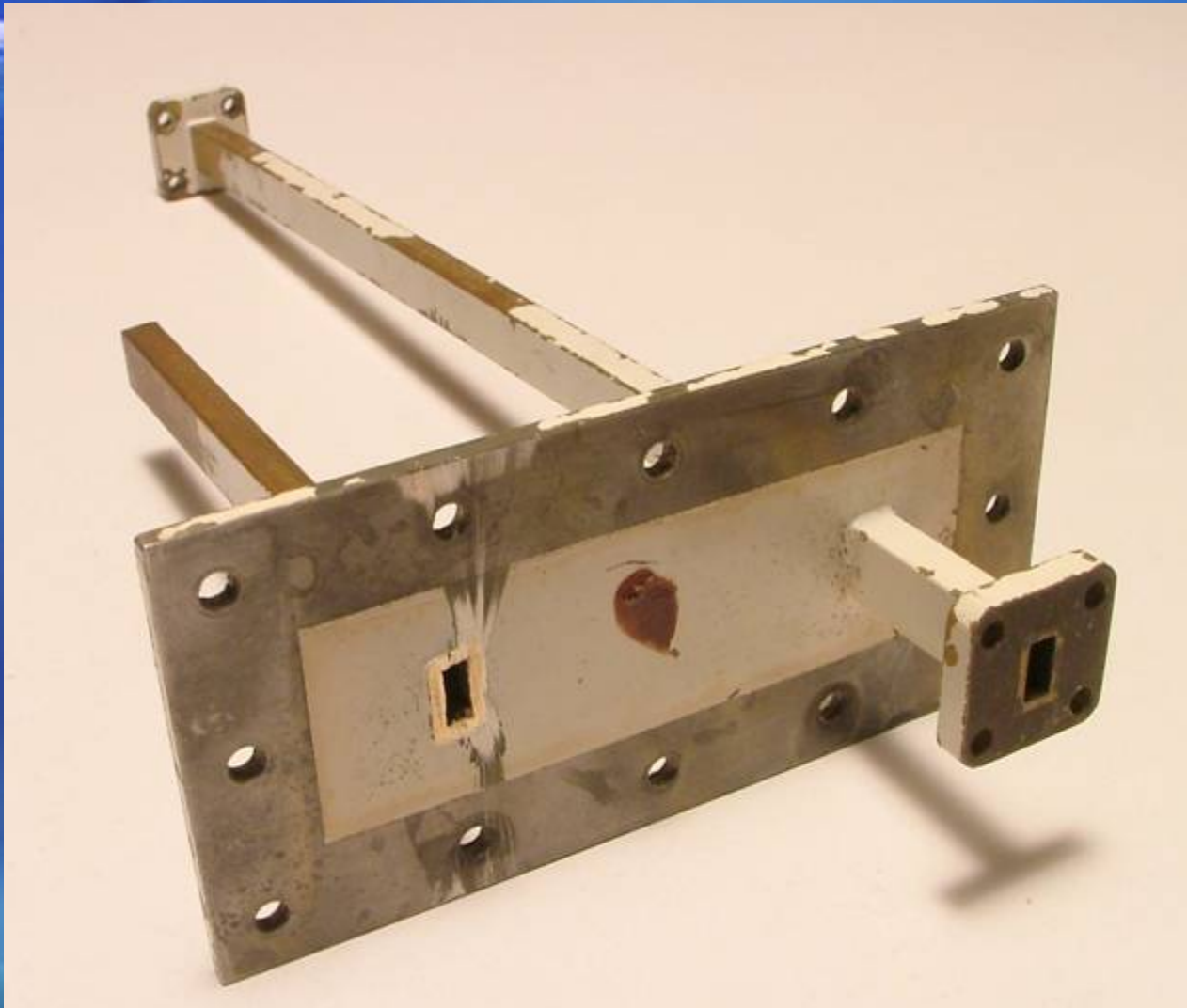
Note “Detector Load Only”

40 GHz

47 GHz

50 GHz

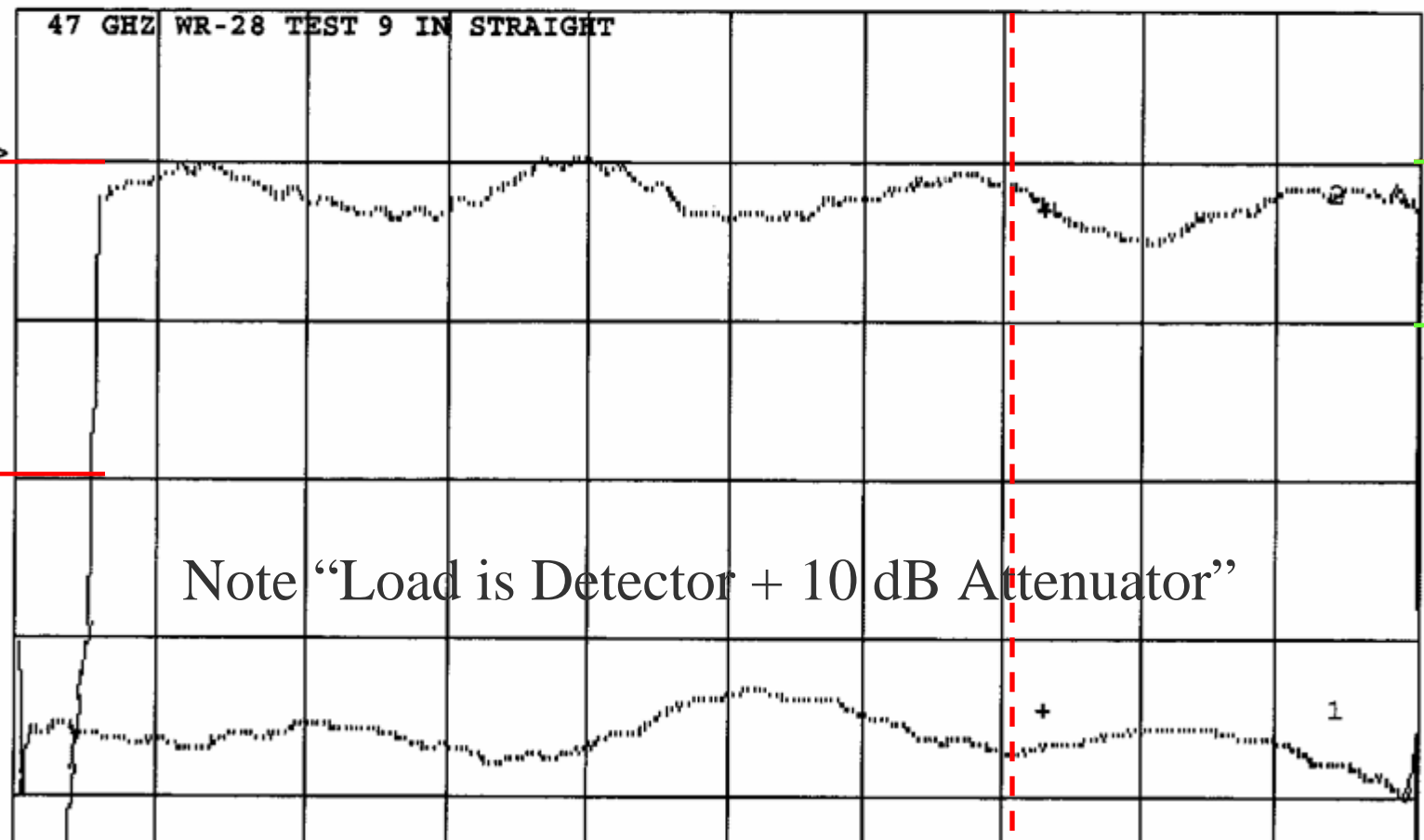
Test Results- “9 Inch” Straight WG



Test Results- “9 Inch” Straight WG

CH1: A -M S - 35.76 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .42 dB
1.0 dB/ REF - .00 dB



40 GHz

47 GHz

50 GHz

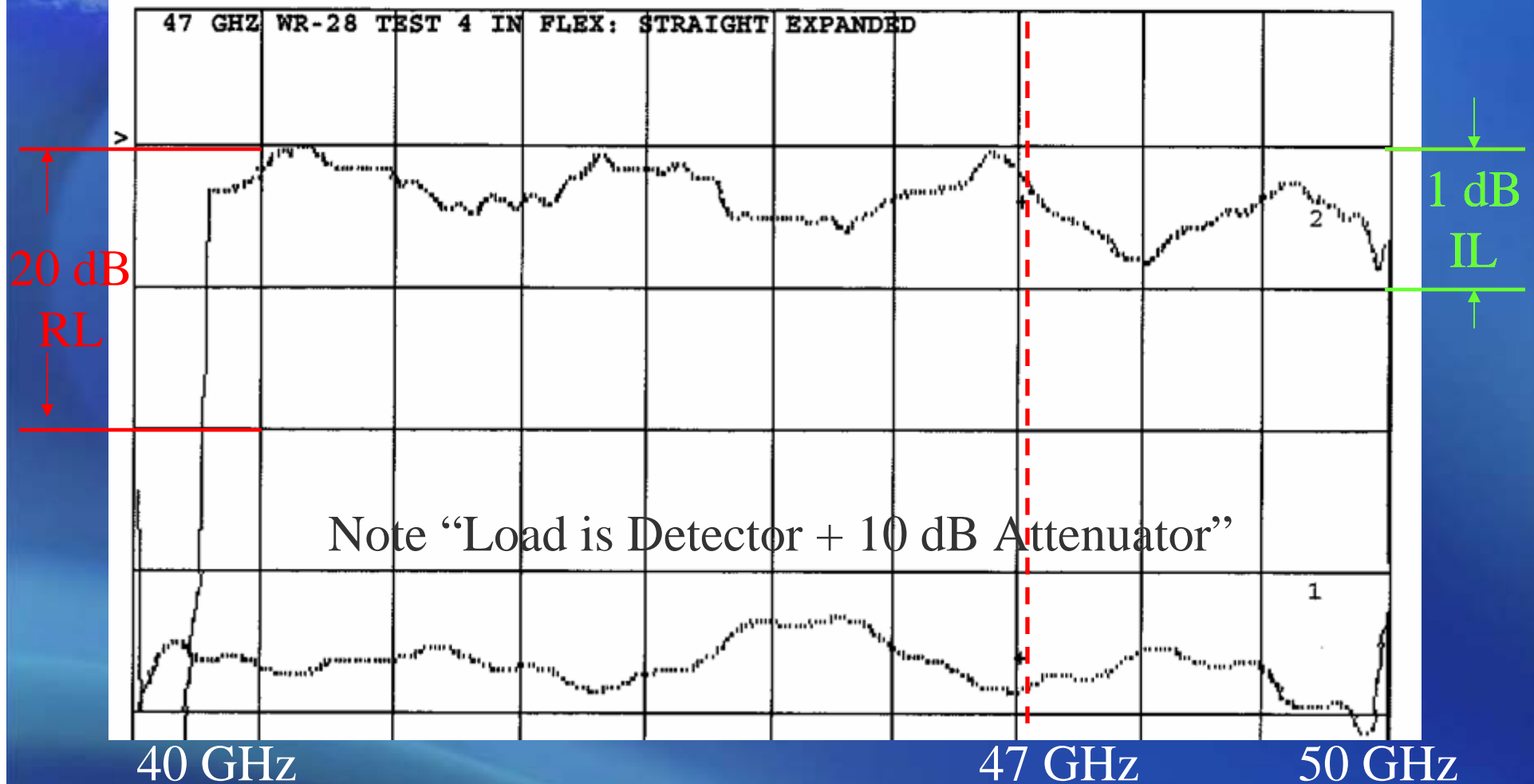
Test Results- “4 Inch” FLEX WG



Test Results- “4 Inch” FLEX WG

CH1: A -M S - 37.35 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .53 dB
1.0 dB/ REF - .00 dB



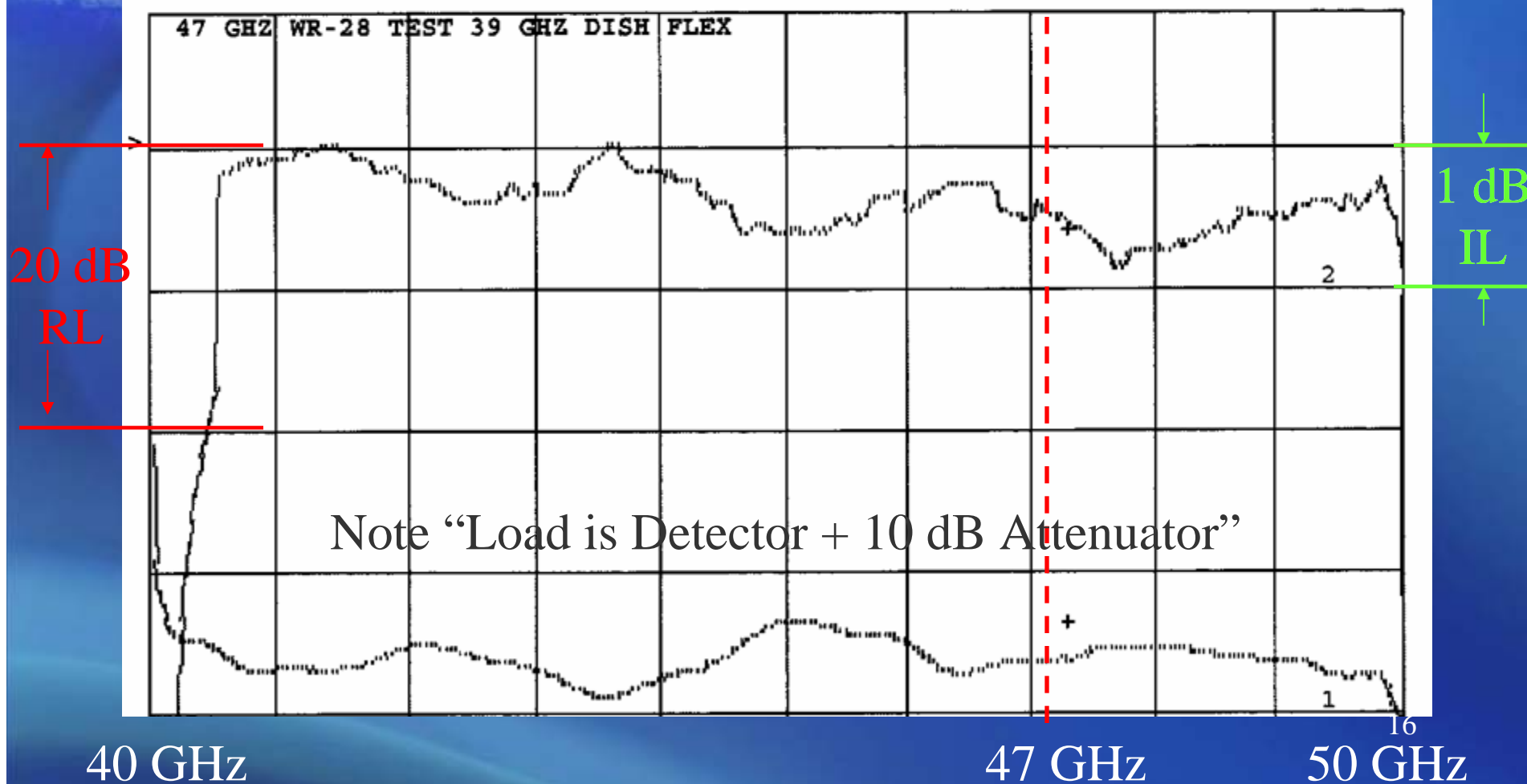
Test Results- “39 GHz Dish” FLEX



Test Results- “39 GHz Dish” FLEX

CH1: A -M S - 35.03 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .71 dB
1.0 dB/ REF - .00 dB



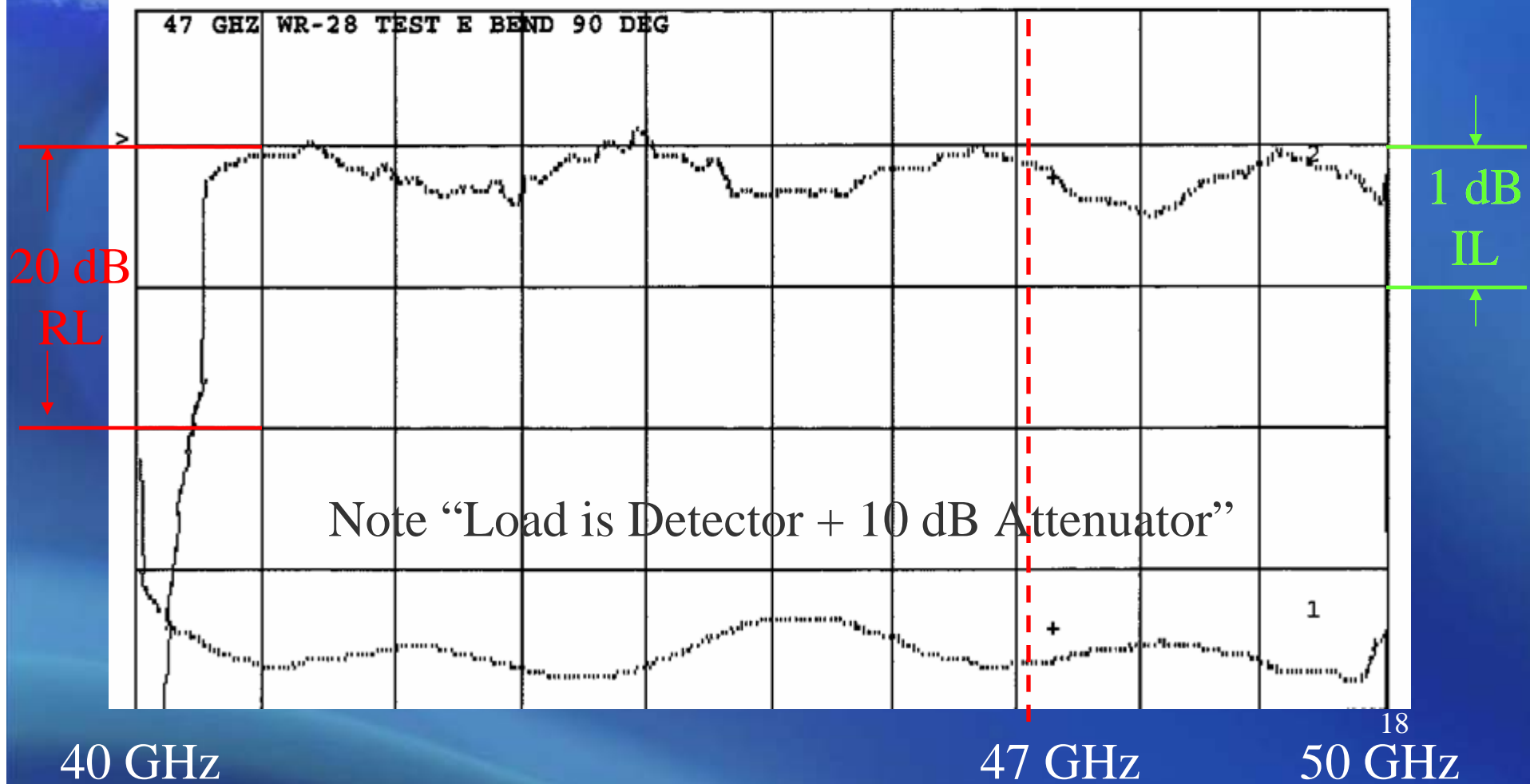
Test Results- ‘E’ Plane Bend



Test Results- “E” Plane Bend

CH1: A -M S - 35.55 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .37 dB
1.0 dB/ REF - .00 dB



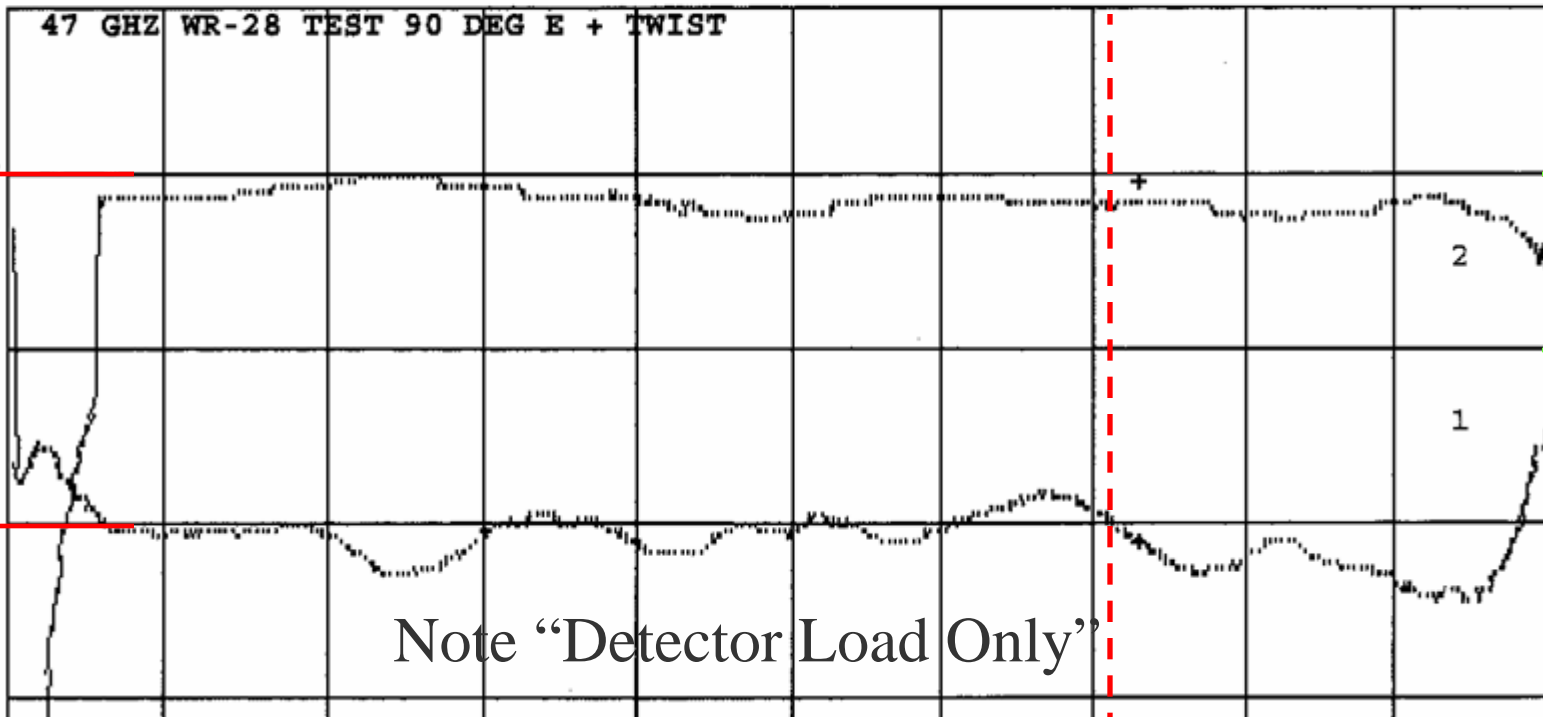
Test Results- ‘E’ Plane Bend + TWIST



Test Results- ‘E’ Plane Bend + TWIST

CH1: A -M S - 22.27 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .18 dB
1.0 dB/ REF - .00 dB



20 dB
RL

1 dB
IL

40 GHz

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50 GHz

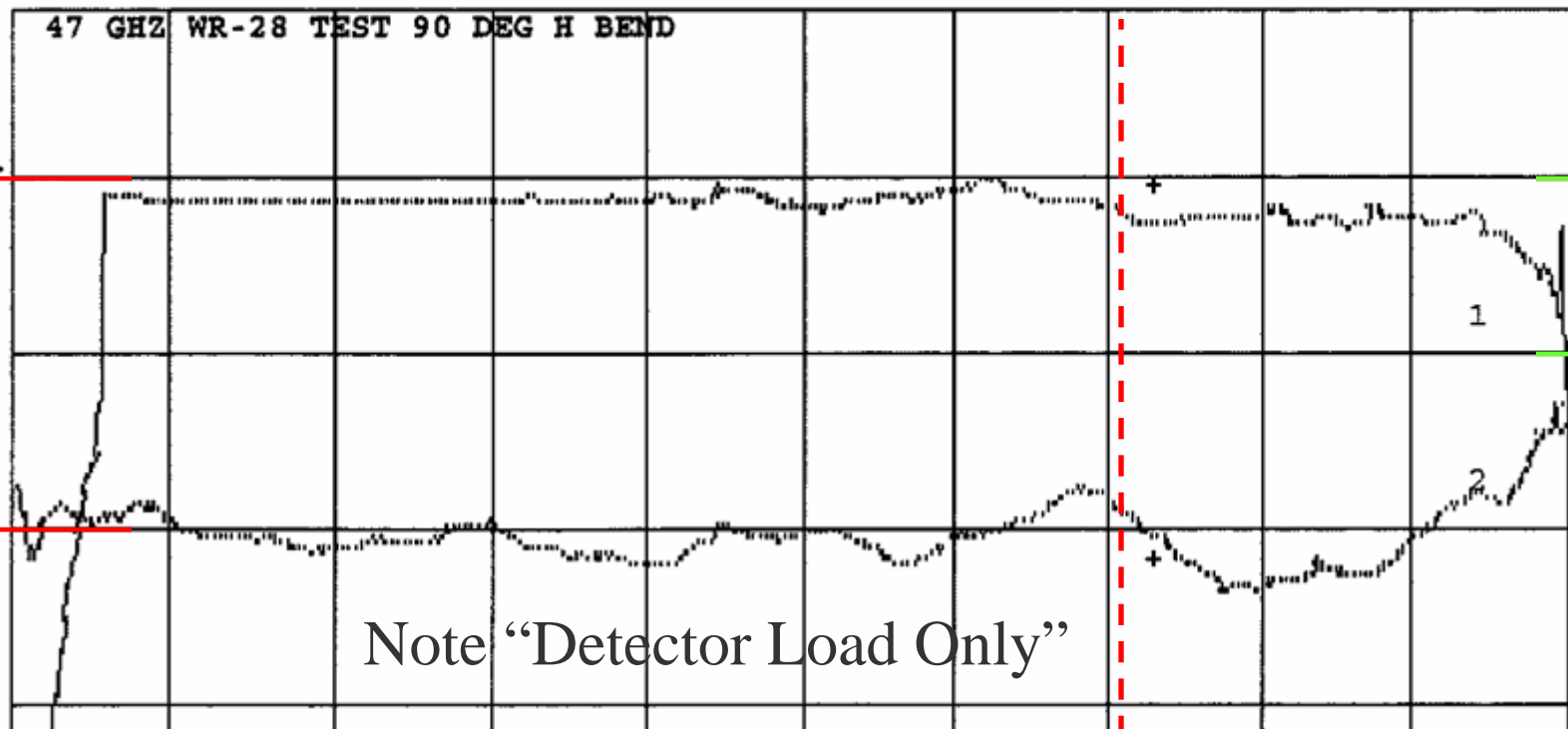
Test Results- “H” Plane Bend



Test Results- “H” Plane Bend

CH1: A -M S - 23.08 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .16 dB
1.0 dB/ REF - .00 dB



20 dB
RL

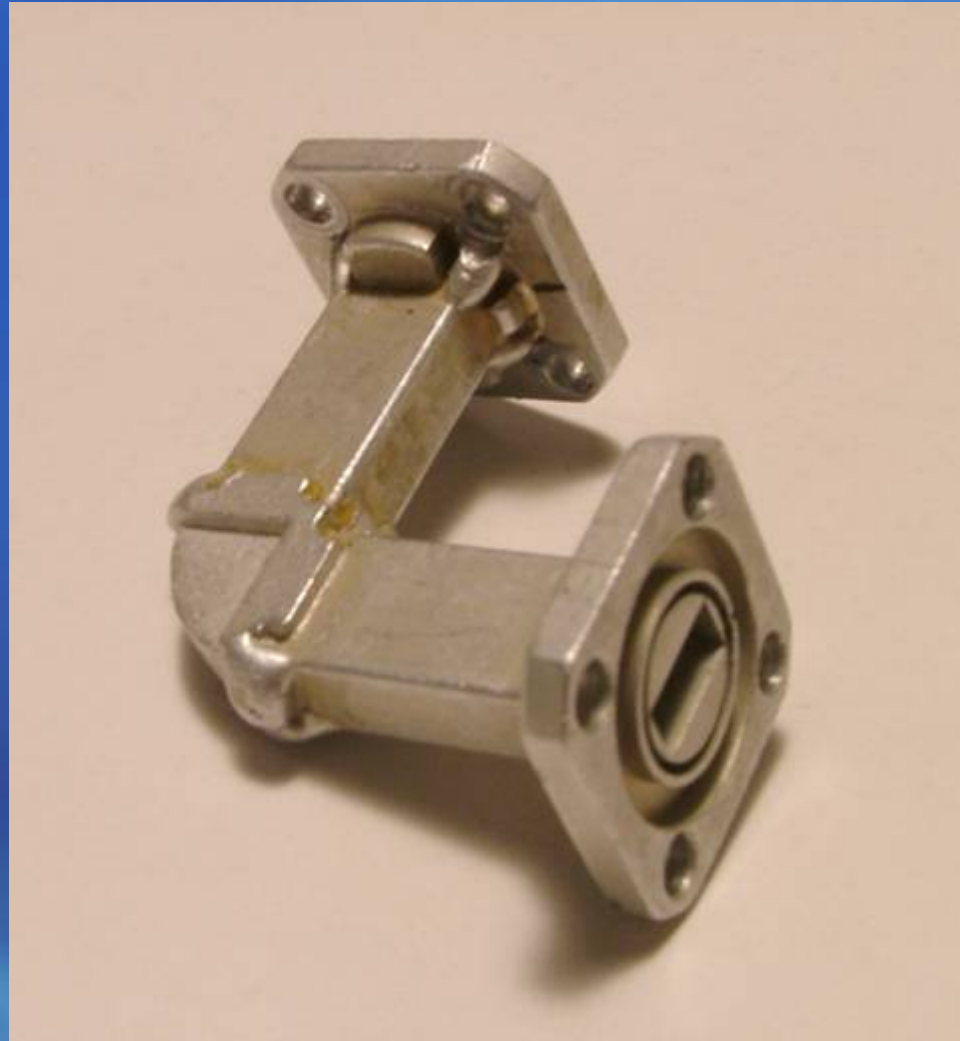
1 dB
IL

40 GHz

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50 GHz

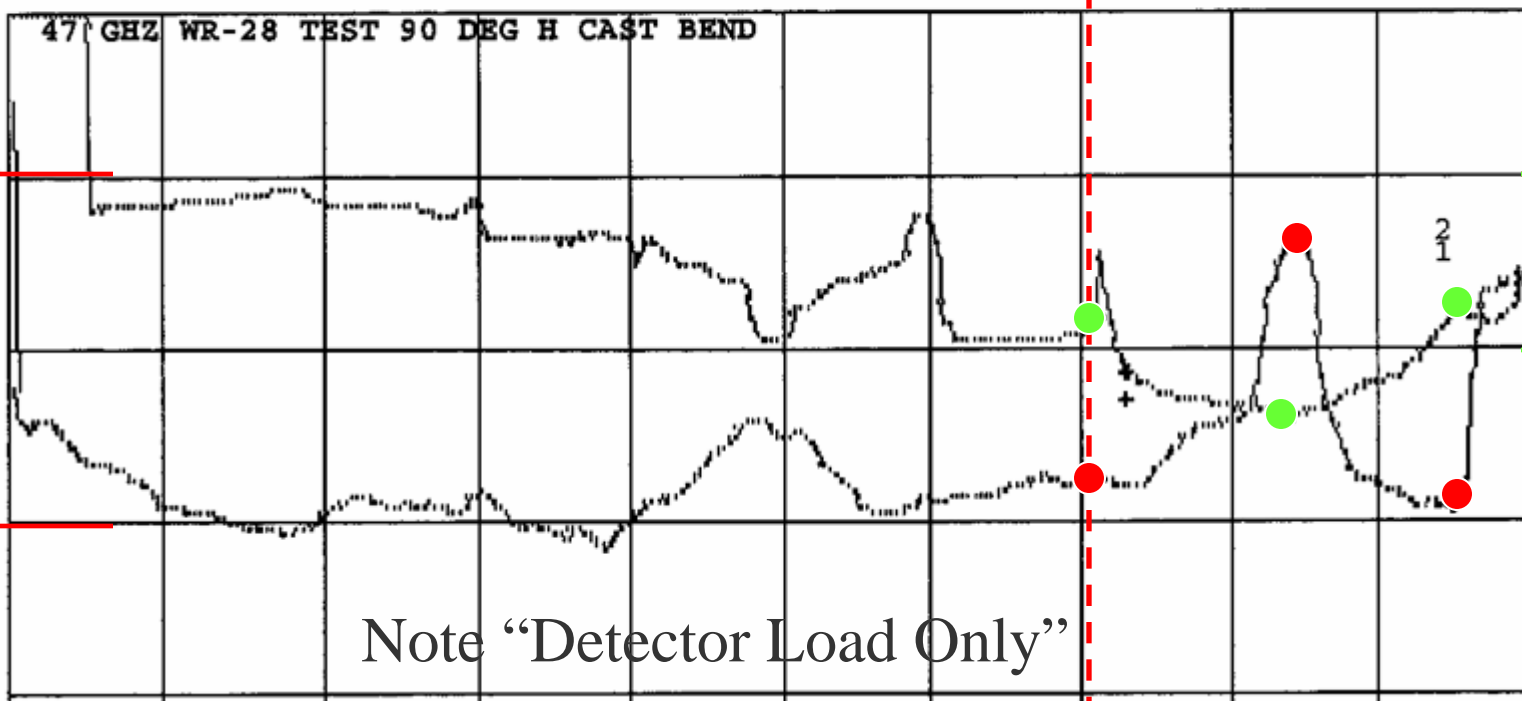
Test Results- CAST ‘H’ Plane Bend



Test Results- CAST ‘H’ Plane Bend

CH1: A -M S - 14.25 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - 1.26 dB
1.0 dB/ REF - .00 dB



20 dB
RL

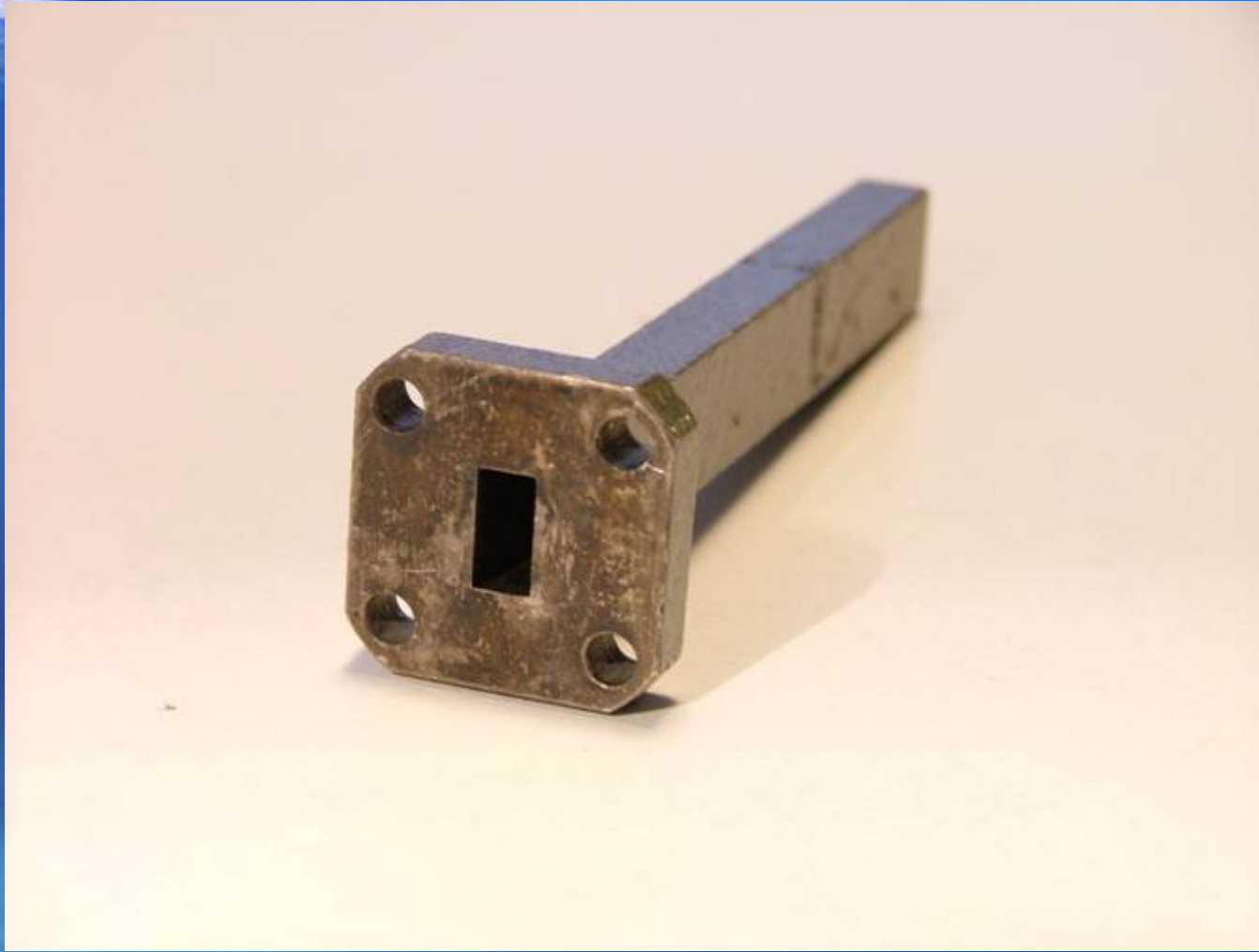
1 dB
IL

40 GHz

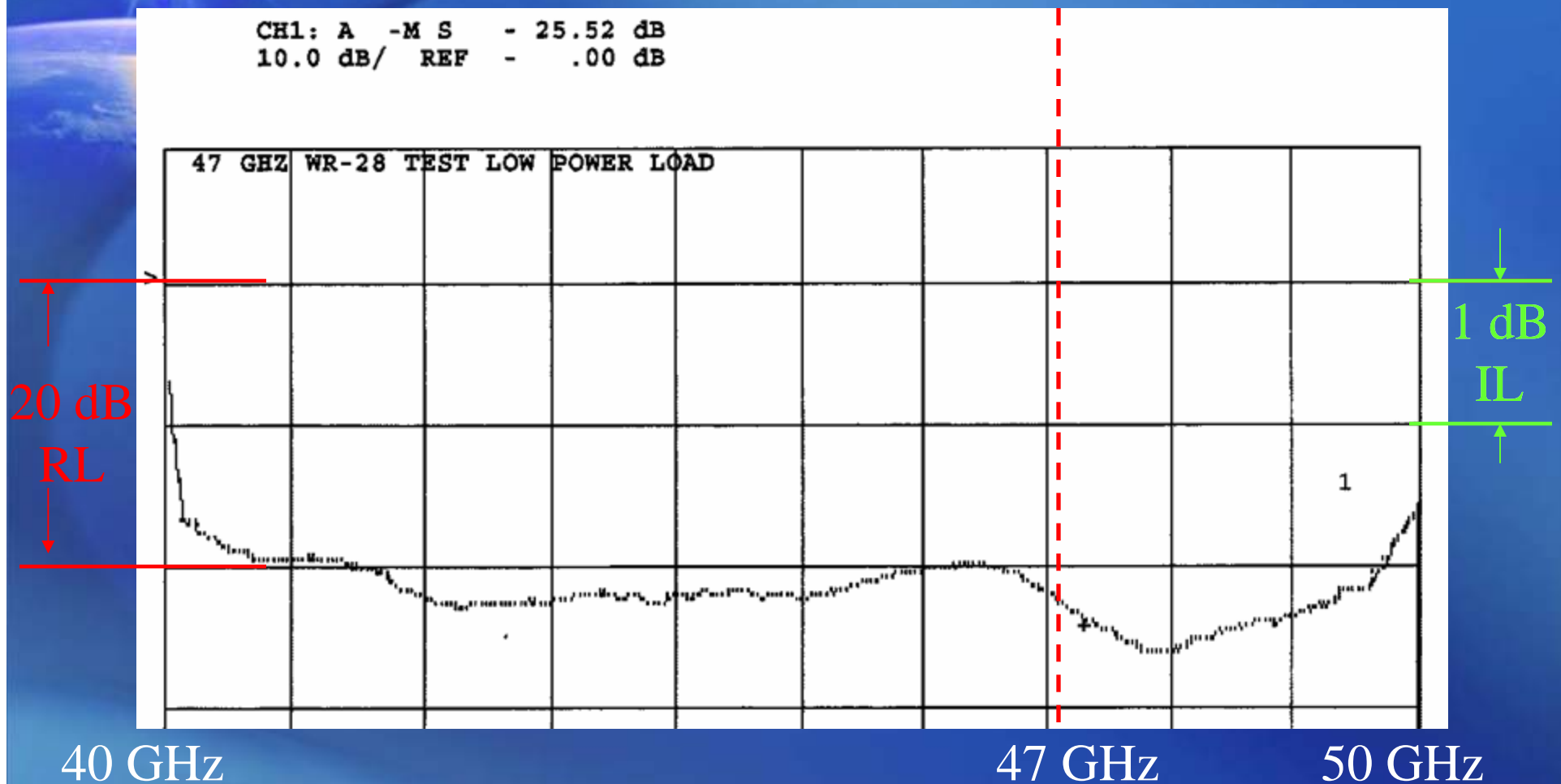
47 GHz

50 GHz

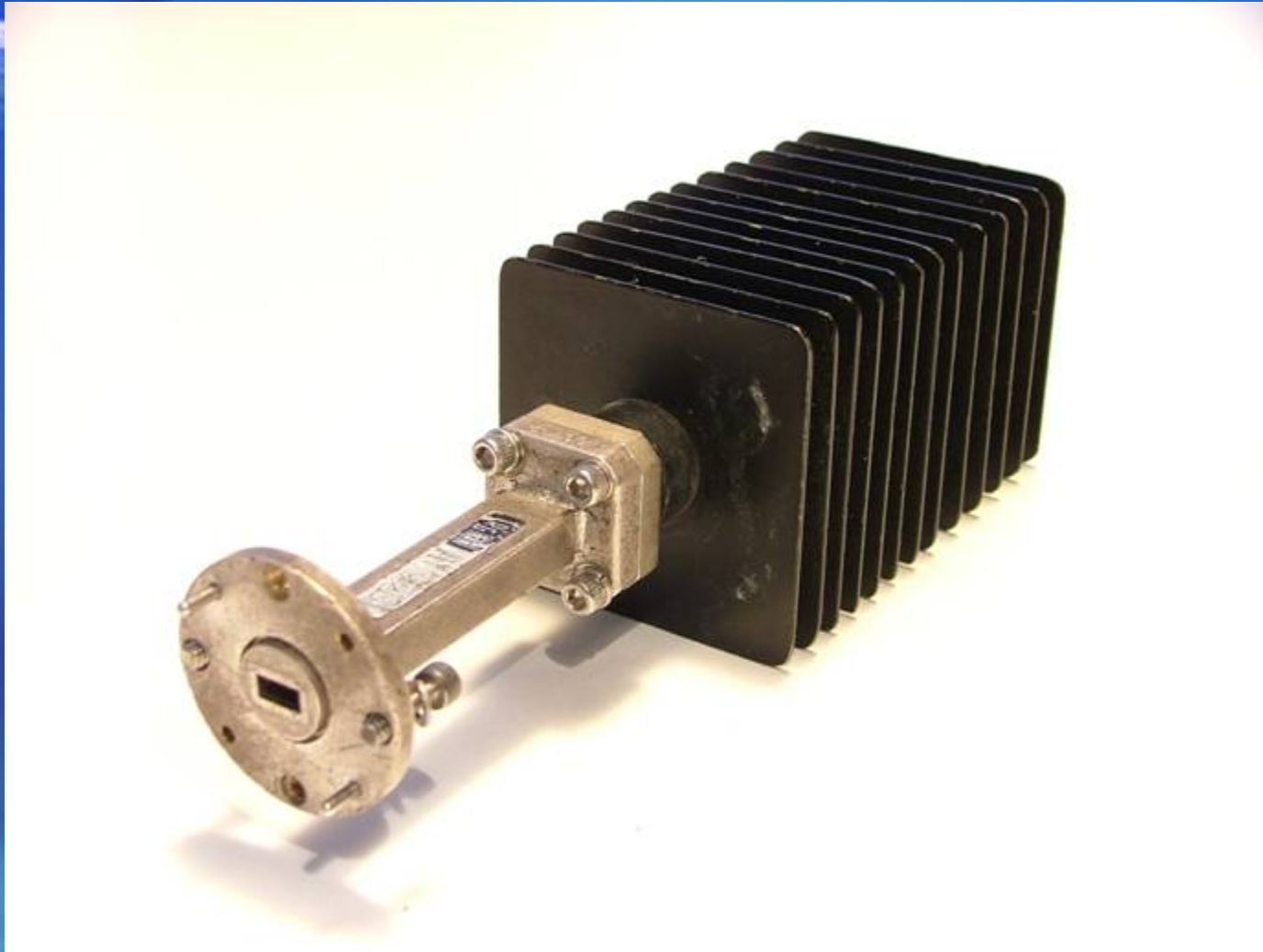
Test Results- Low Power Load



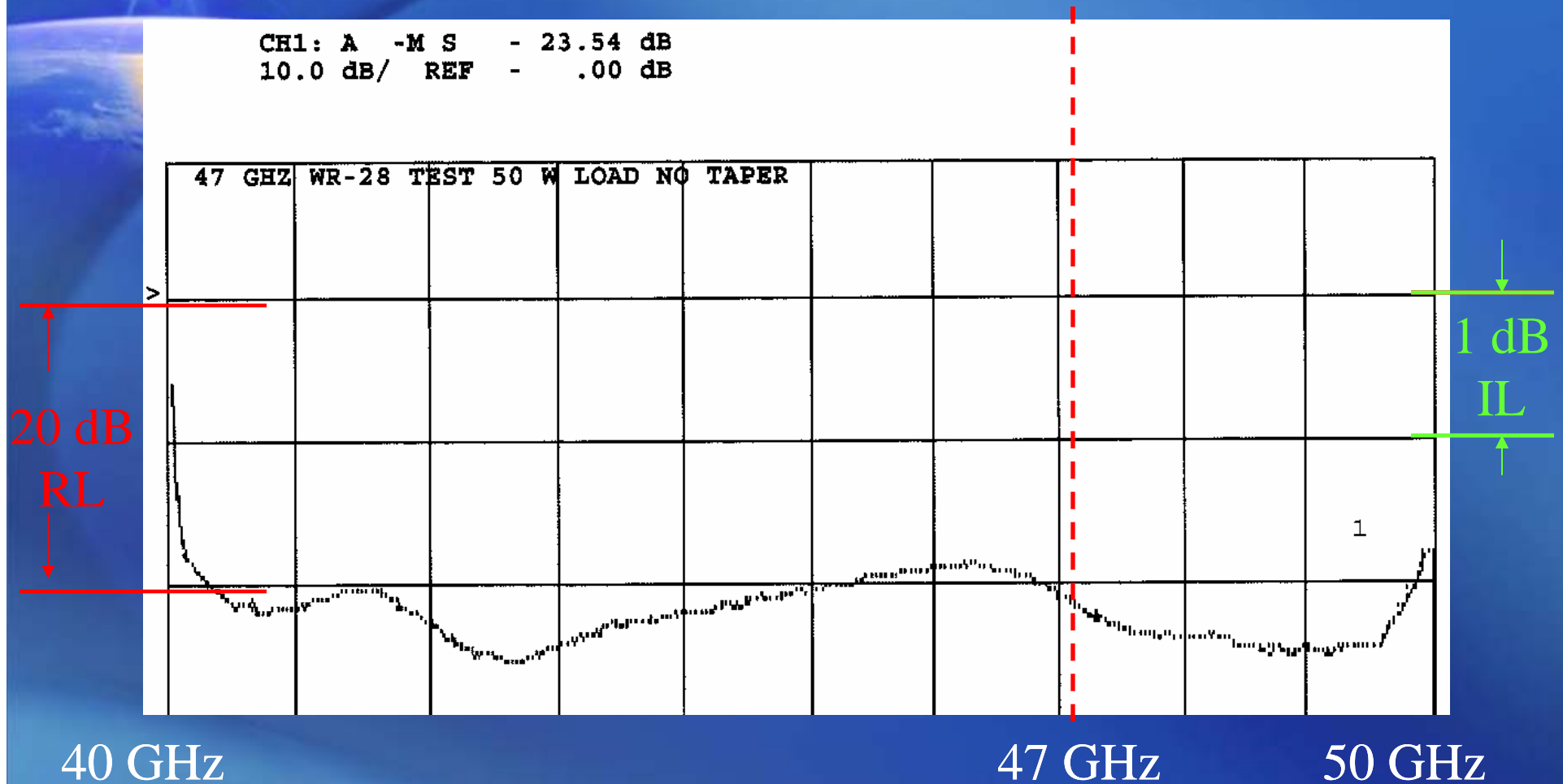
Test Results- Low Power Load



Test Results- High Power Load



Test Results- High Power Load



High Power Load With Taper to WR22

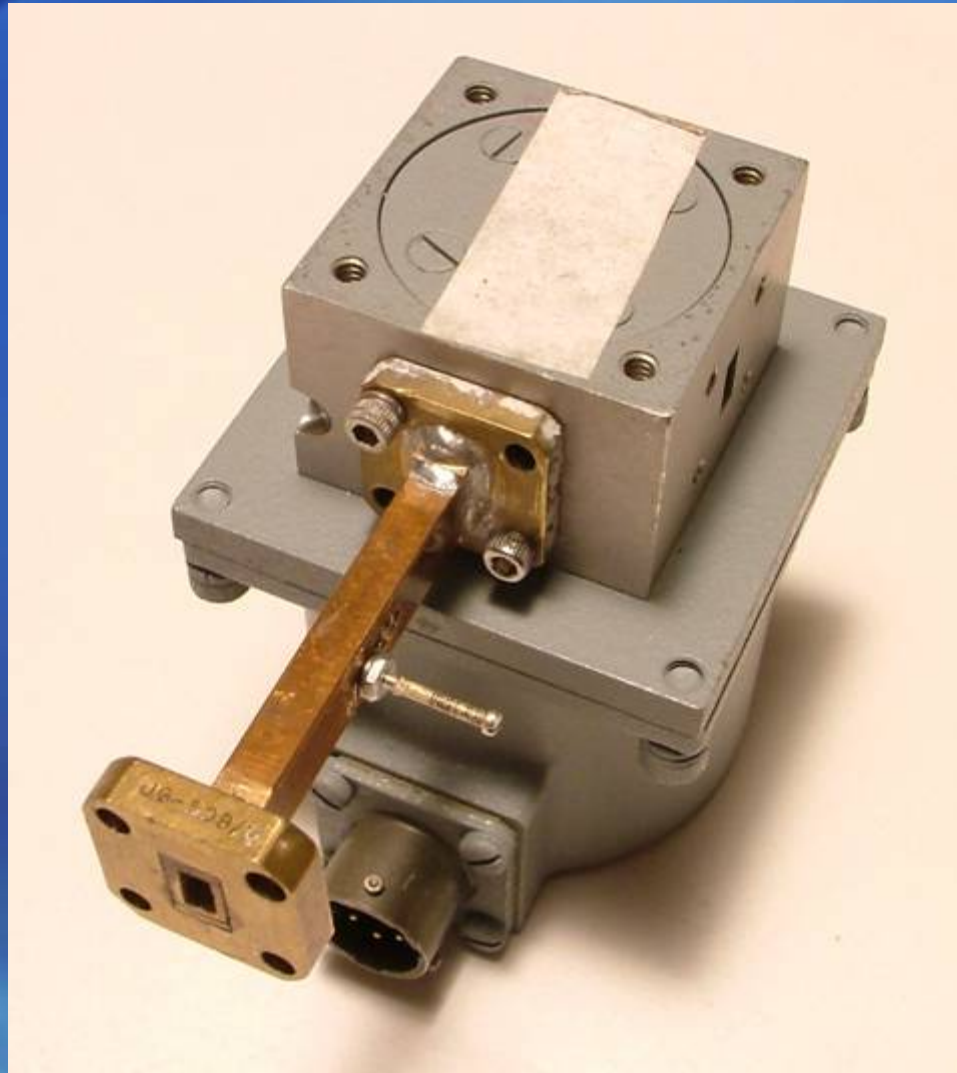


Impedance Matching to WR19/22

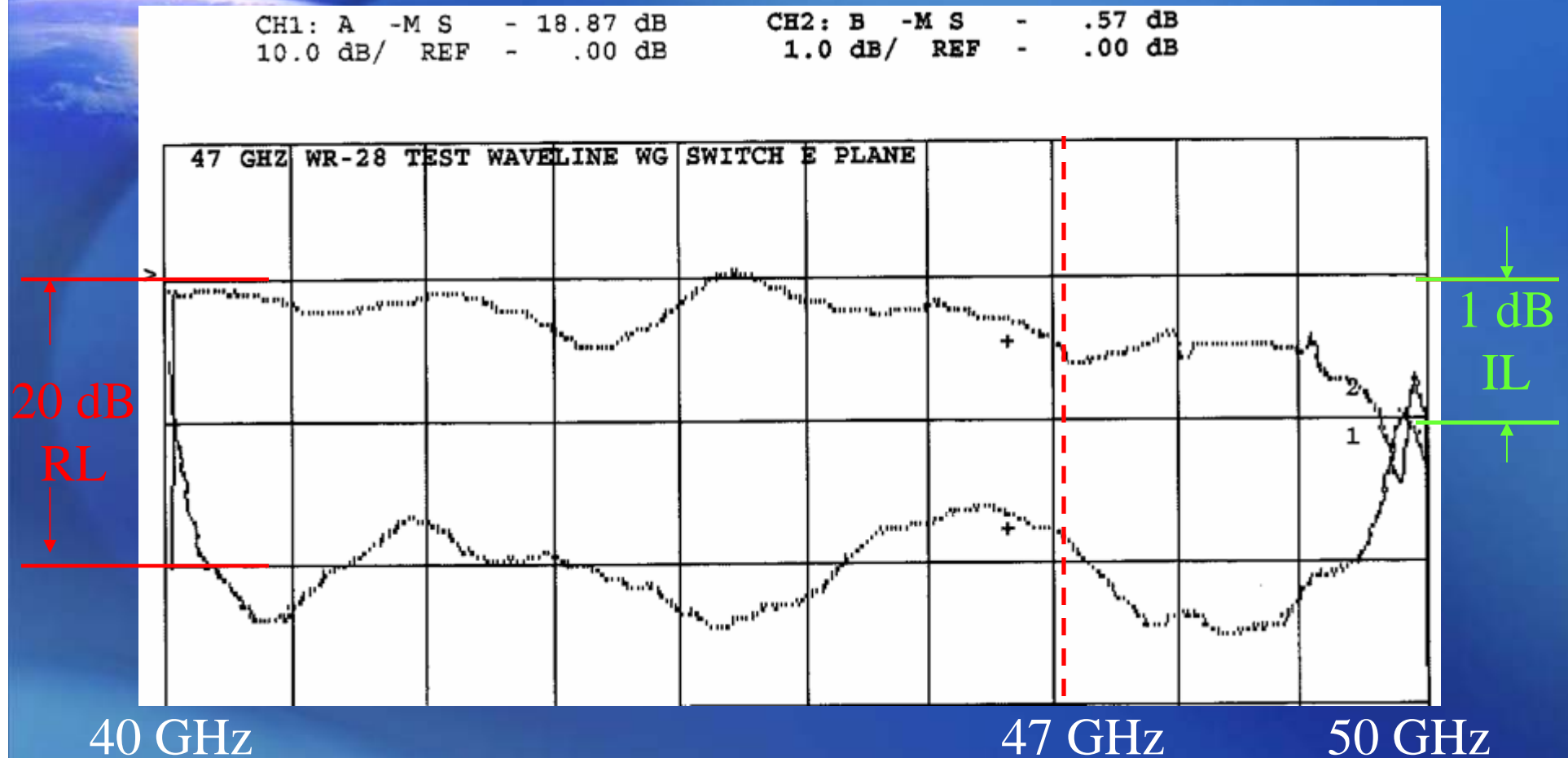
- Can Use Bolted Step Transition
- Smooth Taper Gives Better Broadband Results
- $\frac{1}{4}$ Wavelength Transformer OK for Narrower Bandwidth



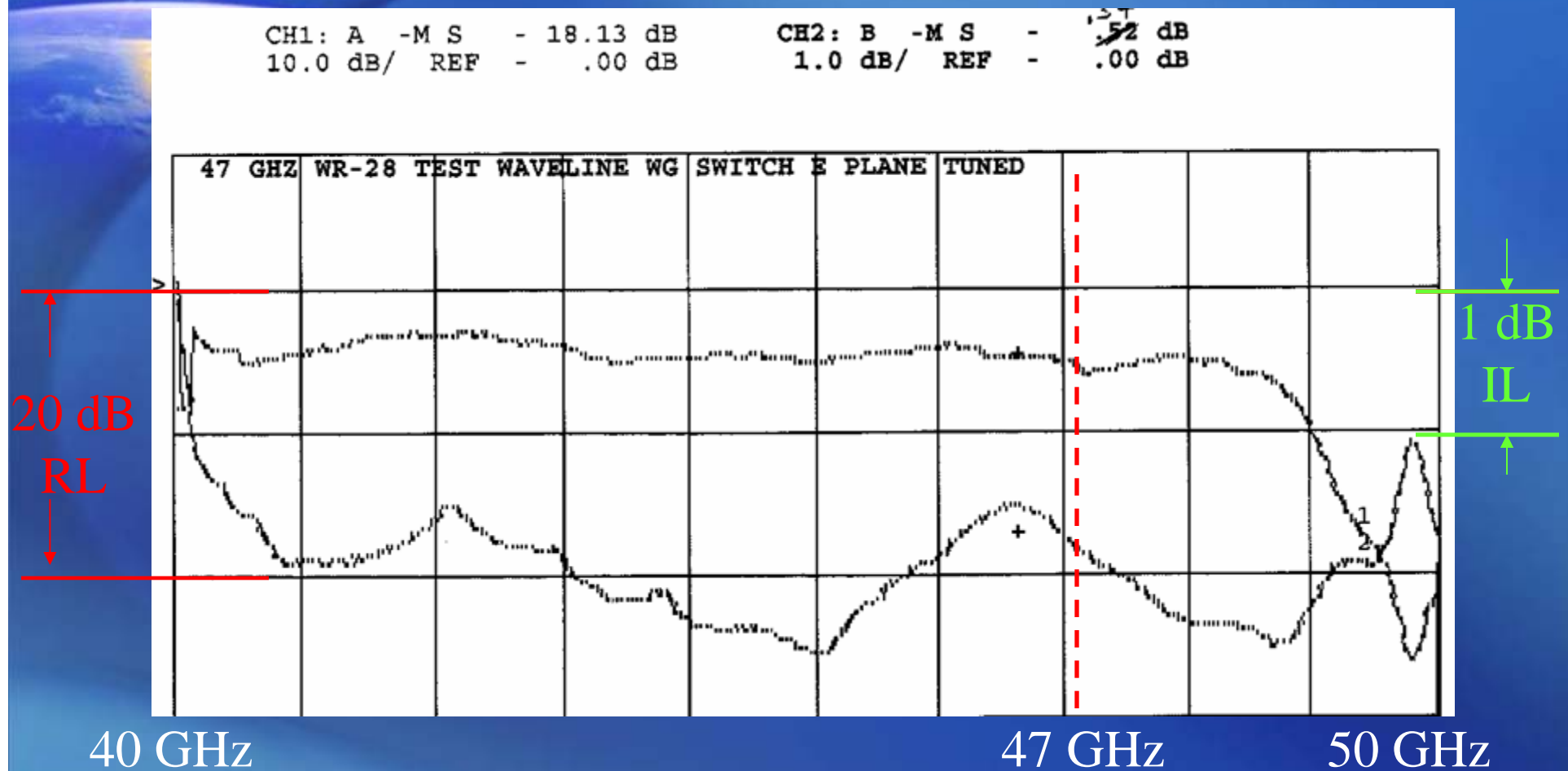
Waveline 1077 ‘E Plane’ WG Switch



Waveline 1077 ‘E Plane’ WG Switch



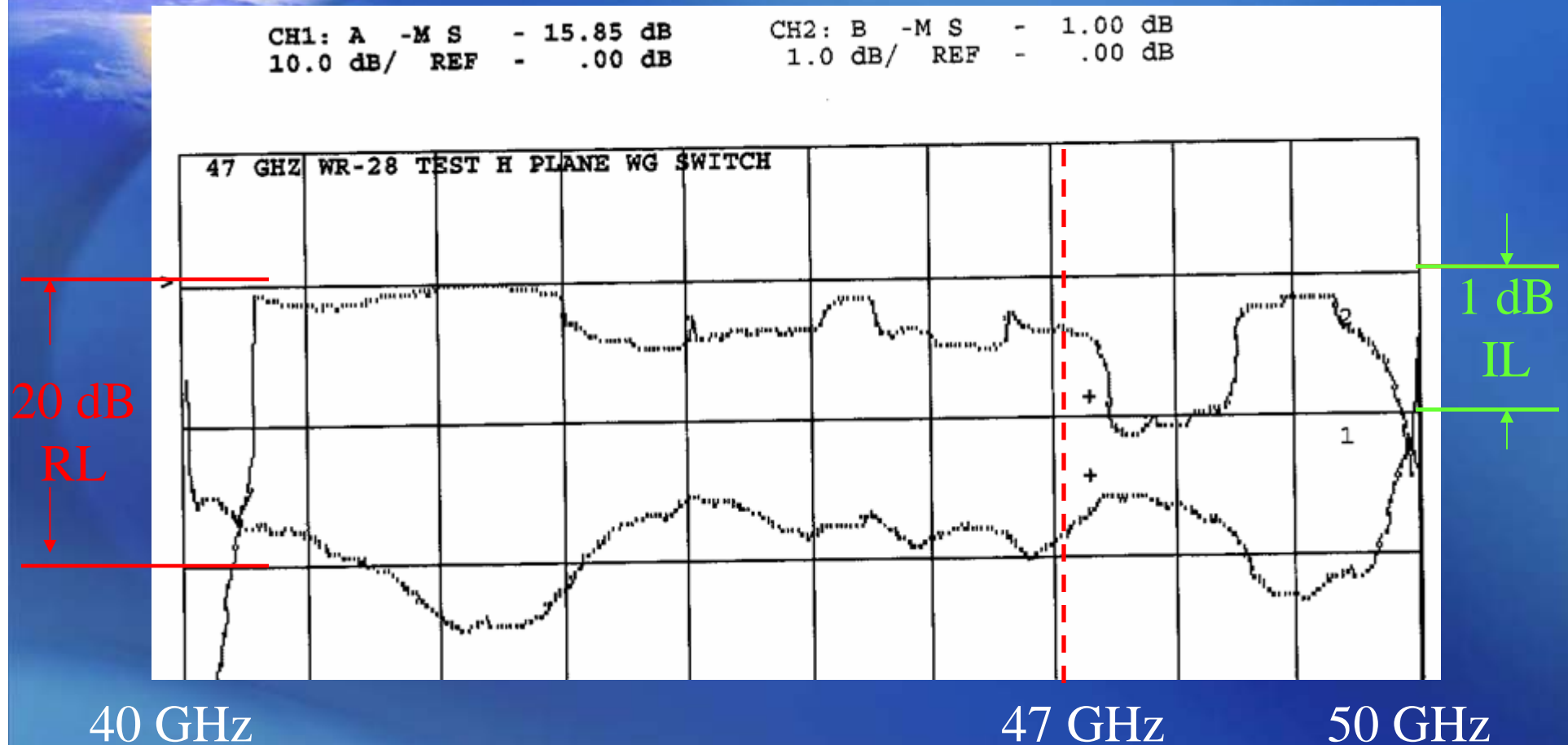
1077 “E Plane” WG Switch “Tuned”



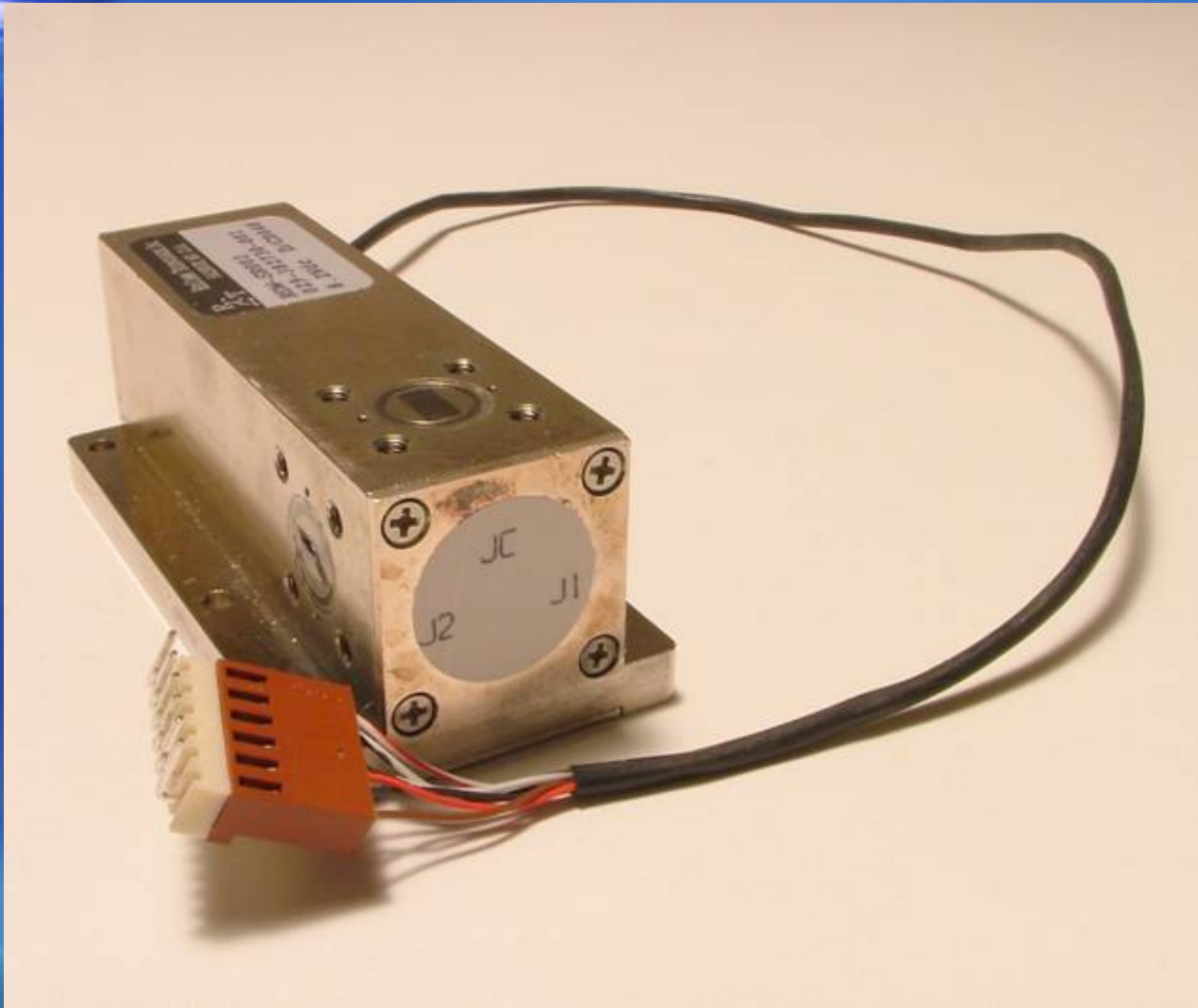
Waveline 1078 “H Plane” WG Switch



Waveline 1078 “H Plane” WG Switch



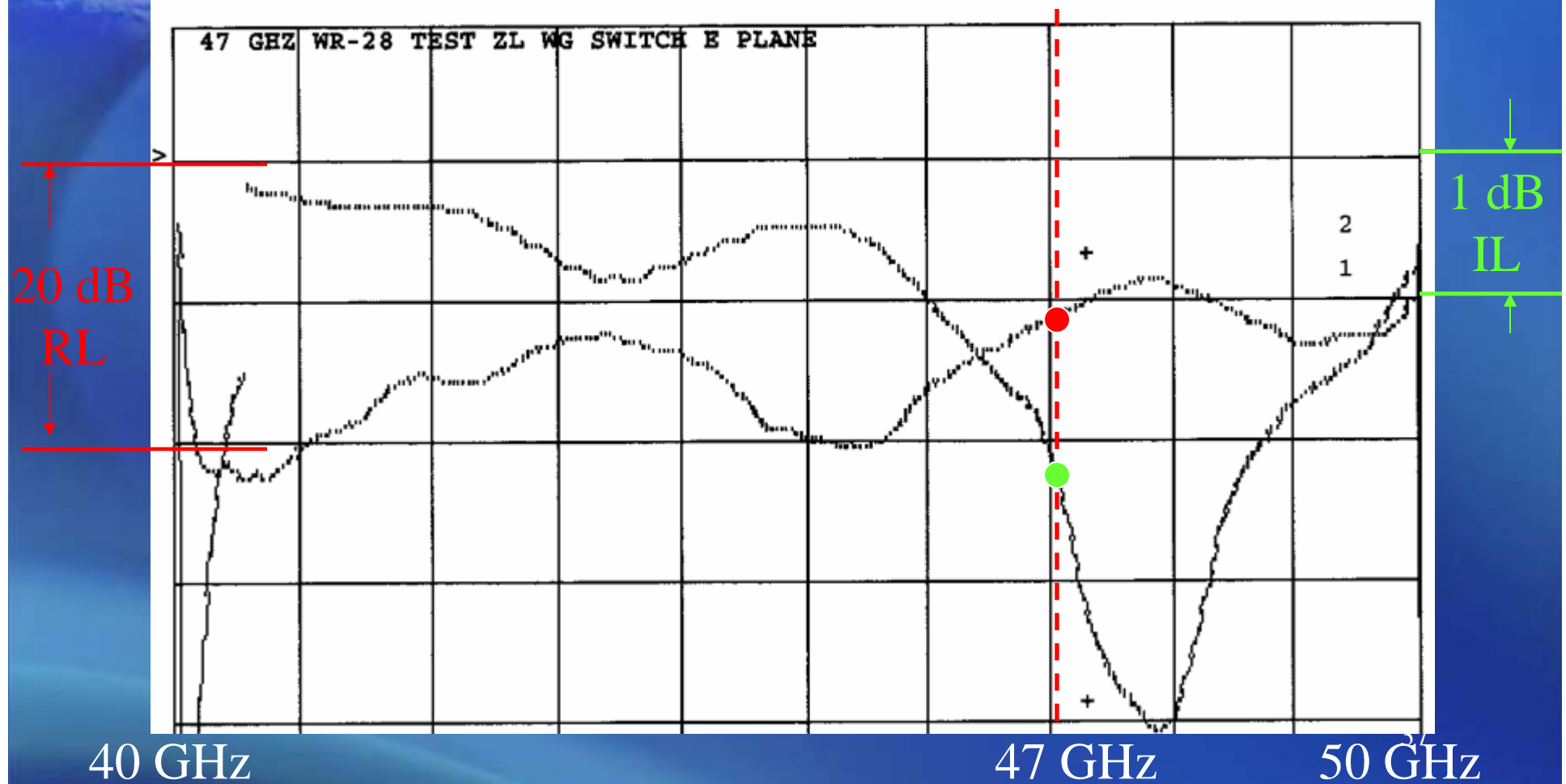
RelComm Tech “ZL” E Plane Switch



RelComm Tech “ZL” E Plane Switch

CH1: A -M S - 8.27 dB
10.0 dB/ REF - .00 dB

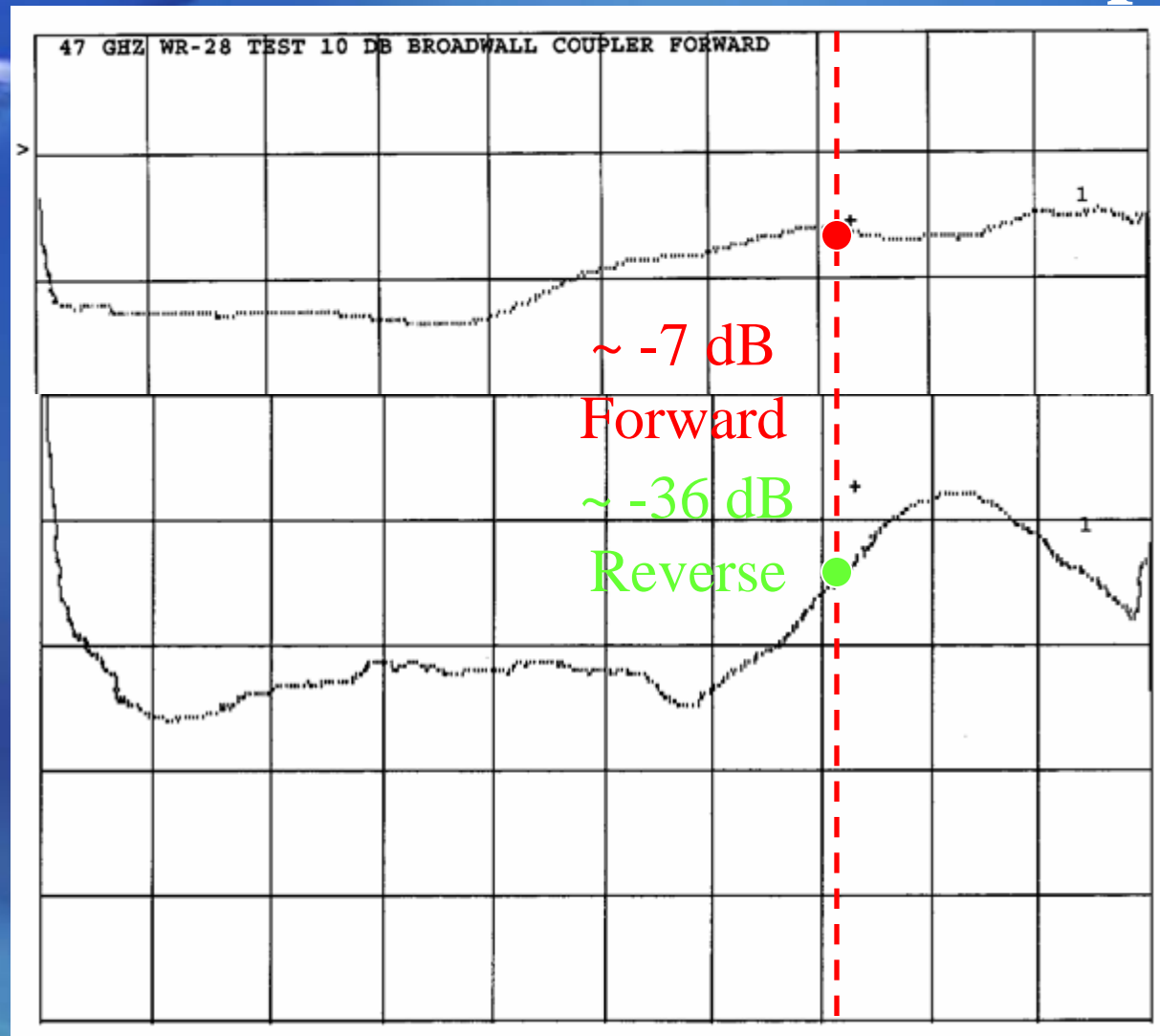
CH2: B -M S - 4.01 dB
1.0 dB/ REF - .00 dB



MCS R382-B Broadwall Coupler



MCS R382-B Broadwall Coupler



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50 GHz

The background of the slide is a deep blue gradient. On the left side, there is a curved horizon of the Earth, showing a thin layer of white clouds and a bright yellow-orange glow from the sun or moon. A bright, multi-pointed starburst light is visible in the upper left corner, casting a soft glow across the scene.

47 GHz WR28 Waveguide Recommendations

- OK to Use WR28 If Lowest Loss Not Req'd
- Use Only Short Straight Sections If Possible
- “E” Bend Best, but Large Radius Preferred
- “H” Plane Bends May Be OK....Test !
- “Cast” 90 Deg Bends VERY BAD
- High Power Loads “OK”, Better With Taper
- Waveline Switches OK, E Plane Best, “ZL” Bad



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