

Use of WR28 Waveguide on 47 GHz?



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Microwave Update, October 2004

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 yellowish glow from the sun or moon just below the horizon. A bright, star-like light source is visible in the upper left corner, casting a lens flare effect across the top of the slide.

Use of WR28 Waveguide on 47 GHz?

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

The background of the slide is a deep blue gradient. In the upper left corner, there is a bright, star-like light source, possibly representing the sun, which creates a lens flare effect. Below the light, the curved horizon of the Earth is visible, showing a thin layer of white clouds and a hint of the blue ocean or land. The overall aesthetic is clean and professional, typical of a technical presentation.

Significance of WR28 Use on 47 GHz?

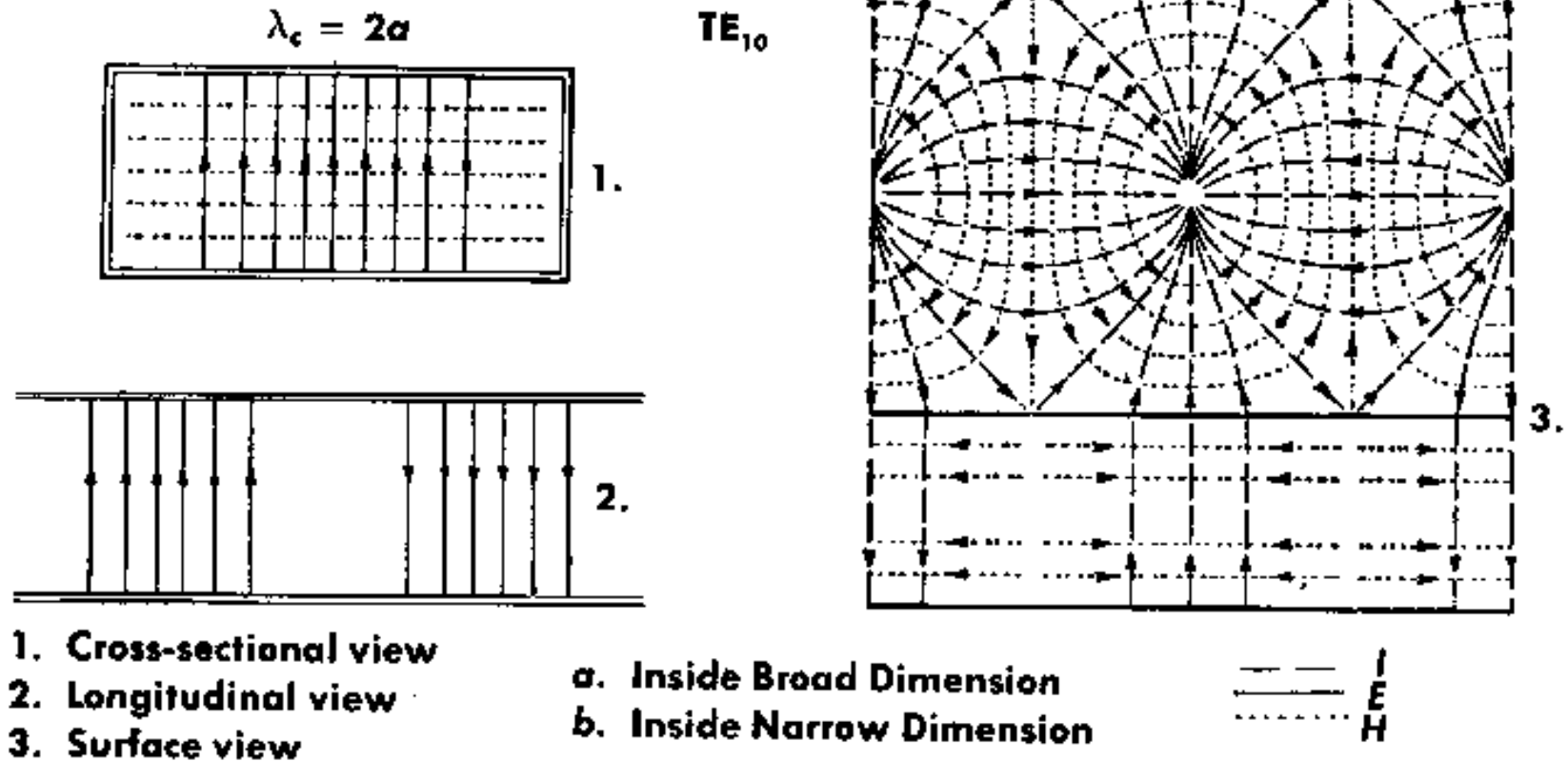
- WR28 is Intended for 26-40 GHz Use
- Readily Available on Surplus Market at Good Prices
- WR22 and WR19 Pieces are Rare and Expensive
- Round & Square Flanges Interconnect with WR22 Waveguide Flanges

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 yellowish glow from the sun or moon. A bright, star-like light source is positioned above the horizon, creating a lens flare effect with several rays of light extending outwards.

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

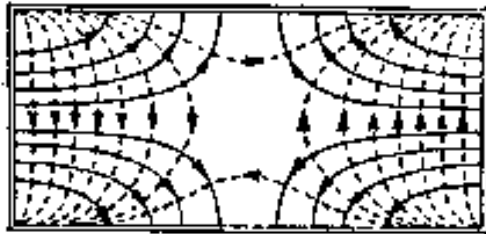
Waveguide Propagation Modes



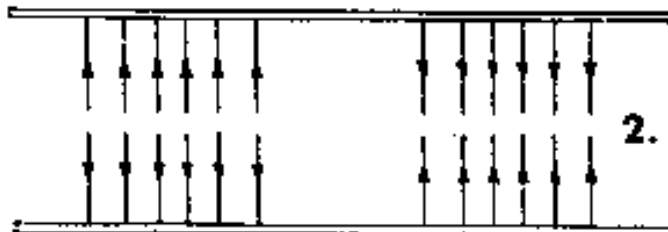
Cutoff Wavelength = 21.1 GHz

Waveguide Propagation Modes

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



1.

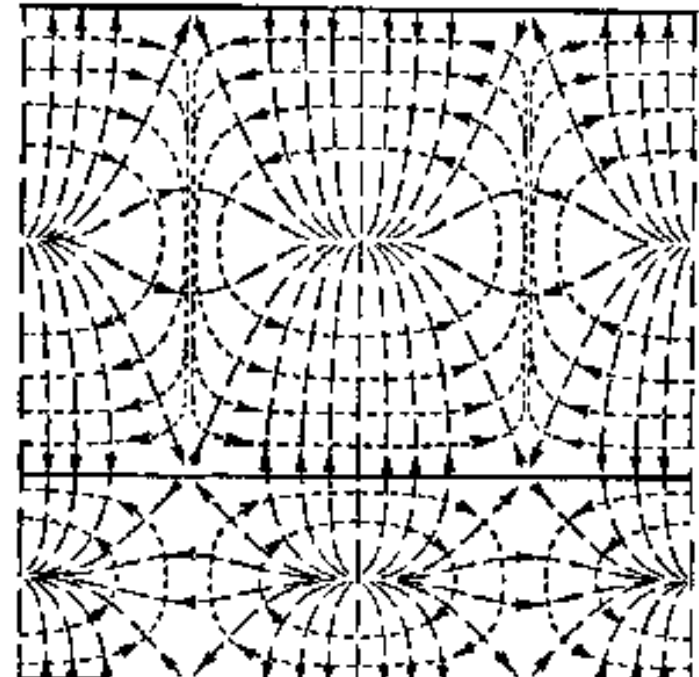


2.

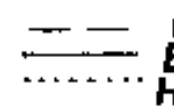
1. Cross-sectional view
2. Longitudinal view
3. Surface view

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

TE₁₁



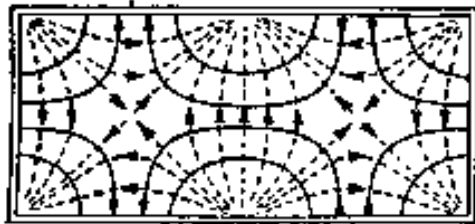
3.



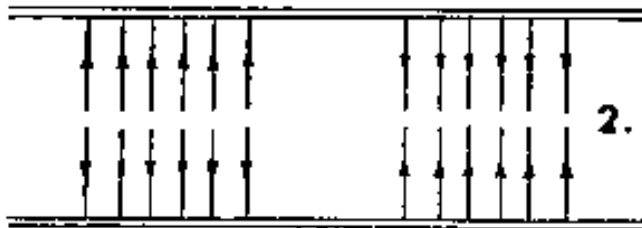
Cutoff Wavelength = 47.2 GHz

Waveguide Propagation Modes

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



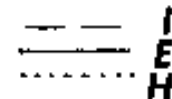
1.



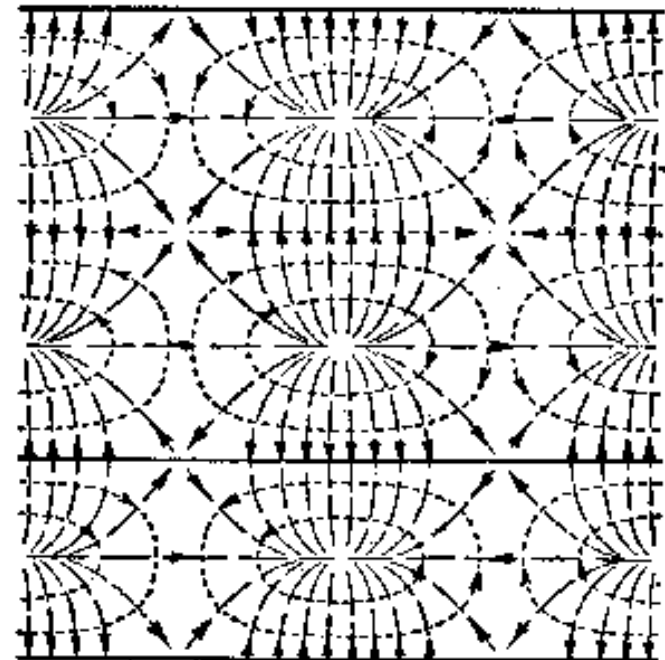
2.

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

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



TE_{21}



3.

Cutoff Wavelength = 59.6 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 yellowish glow from the sun or moon. A bright, starburst-like light source is visible in the upper left corner, casting a beam of light across the scene.

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

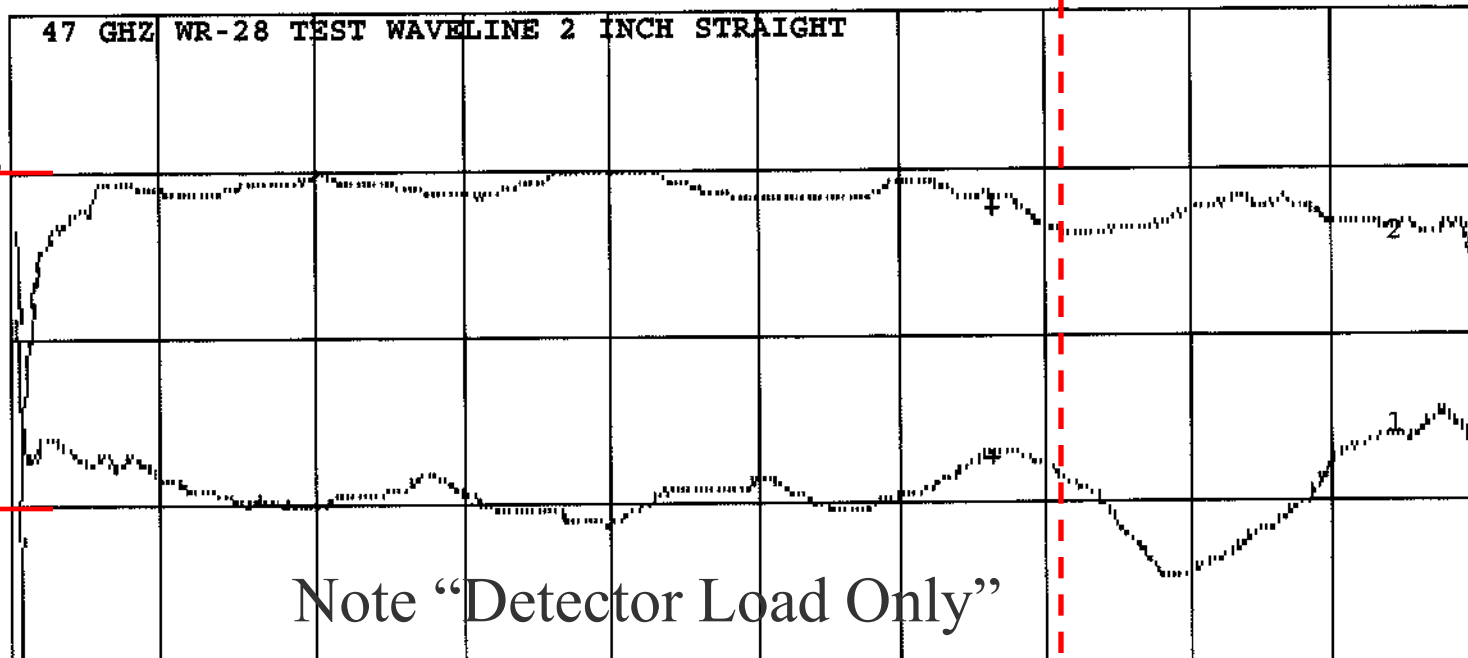
Test Results- “2 Inch” Straight WG



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



20 dB
RL

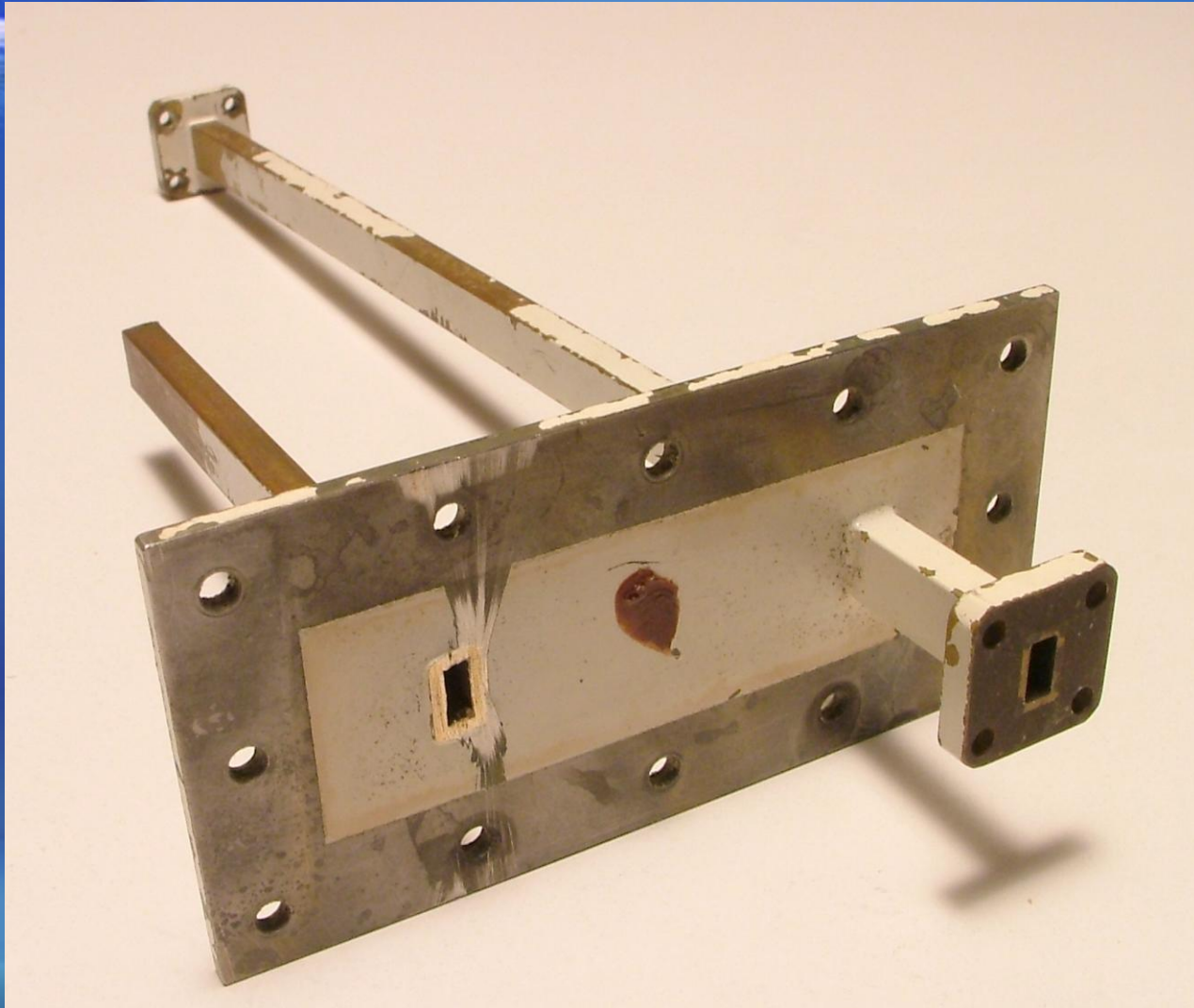
1 dB
IL

40 GHz

47 GHz

50 GHz

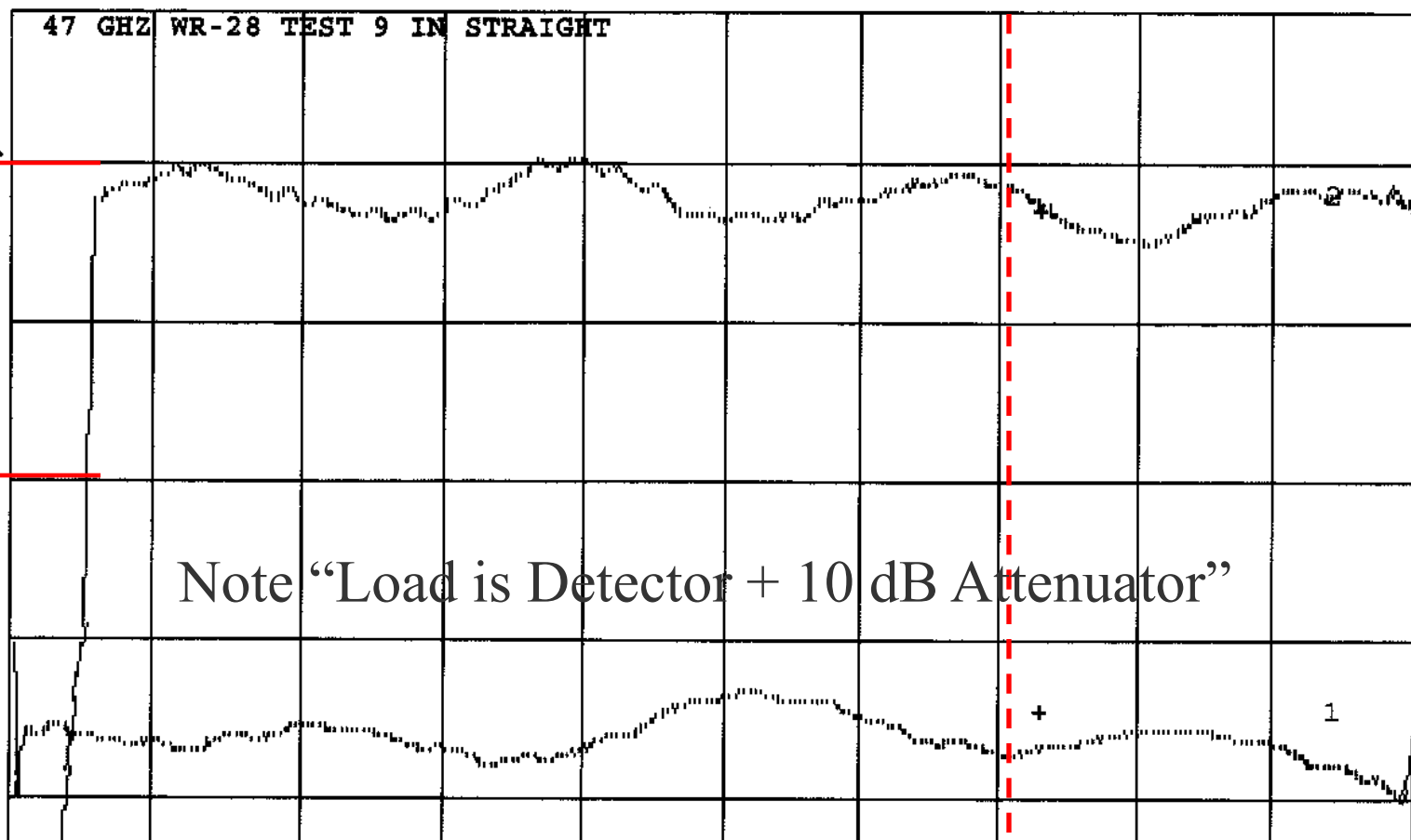
Test Results- “9 Inch” Straight WG



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



1 dB
IL

40 GHz

47 GHz

50 GHz

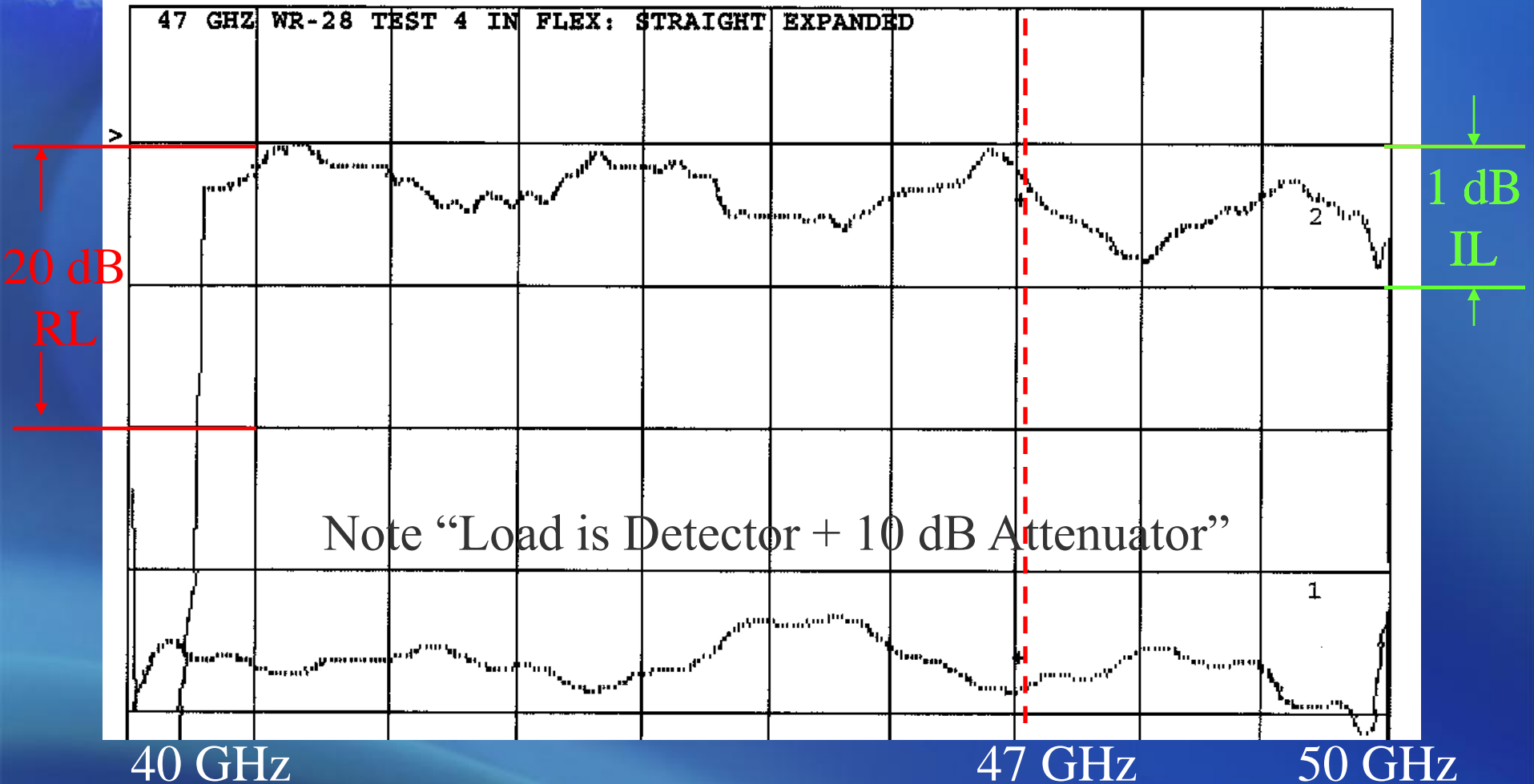
Test Results- “4 Inch” FLEX WG



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



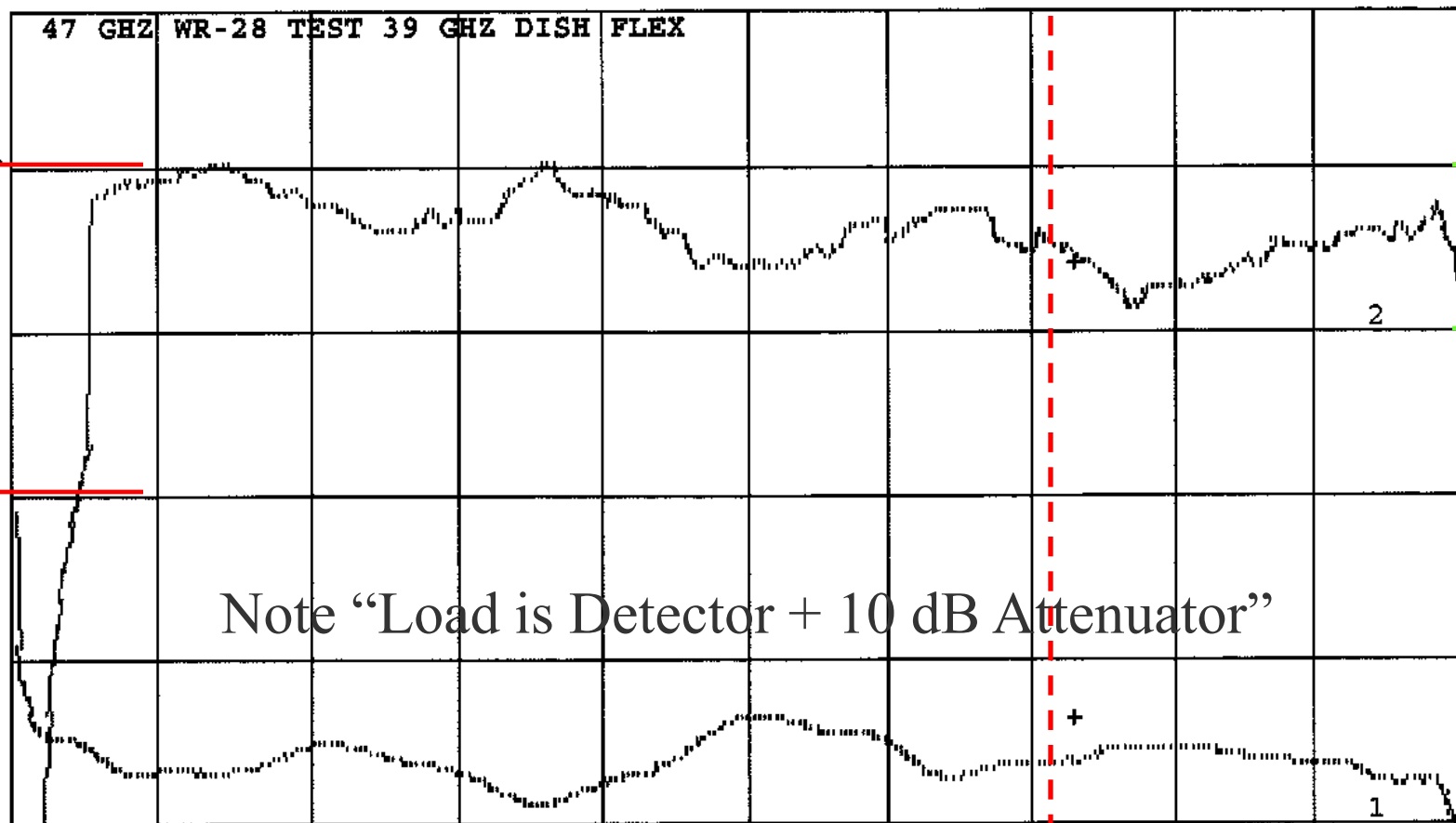
Test Results- “39 GHz Dish” FLEX



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



40 GHz

47 GHz

50 GHz

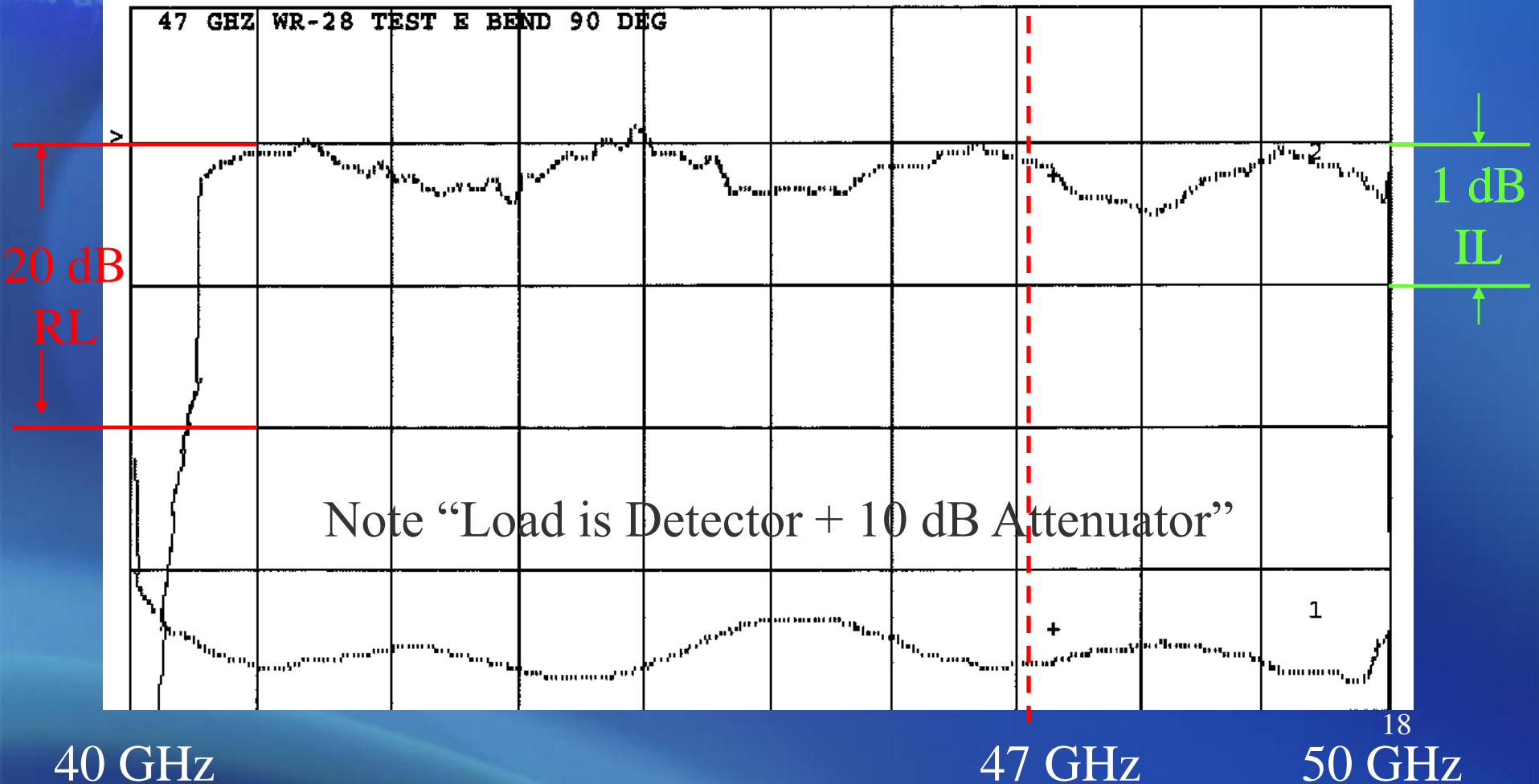
Test Results- “E” Plane Bend



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



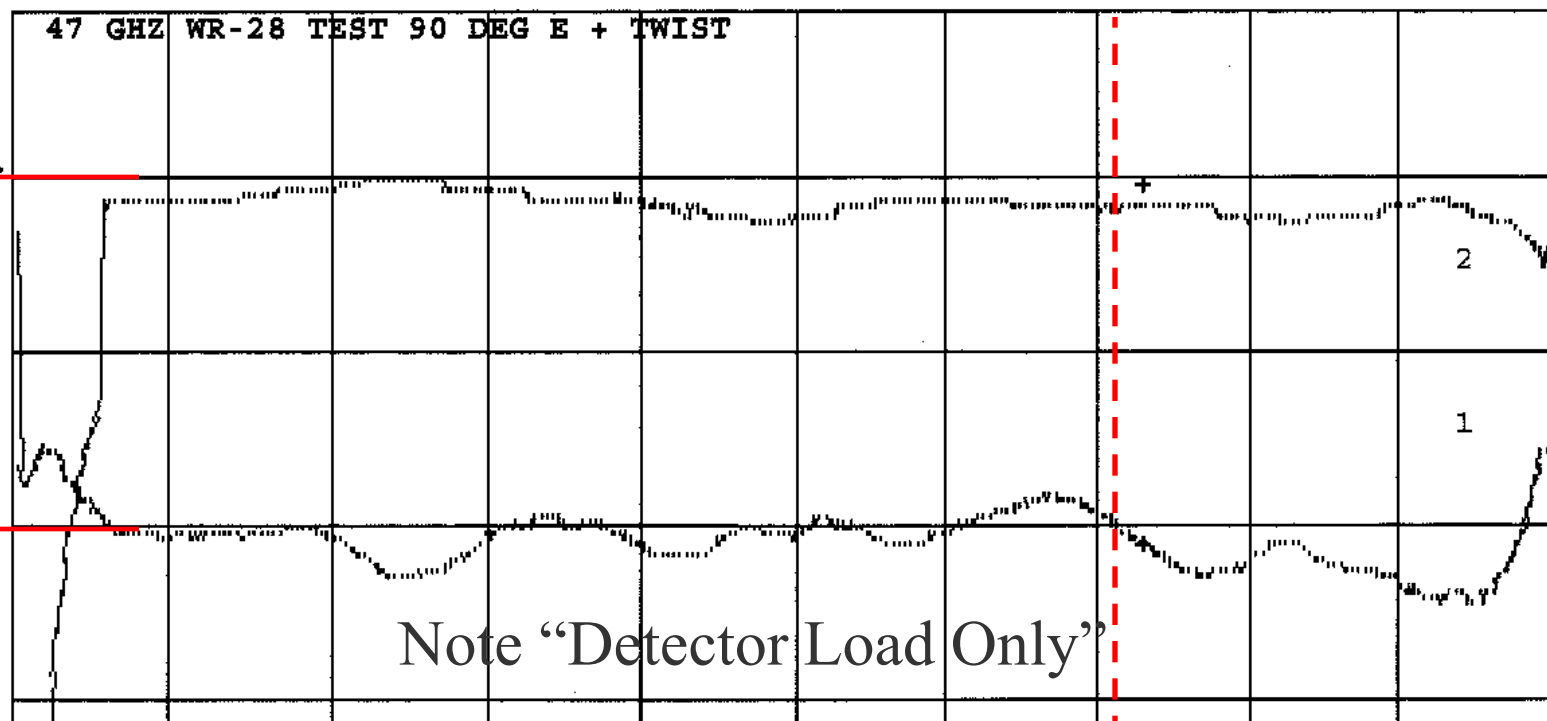
Test Results- “E” Plane Bend + TWIST



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



40 GHz

47 GHz

50 GHz

Test Results- “H” Plane Bend

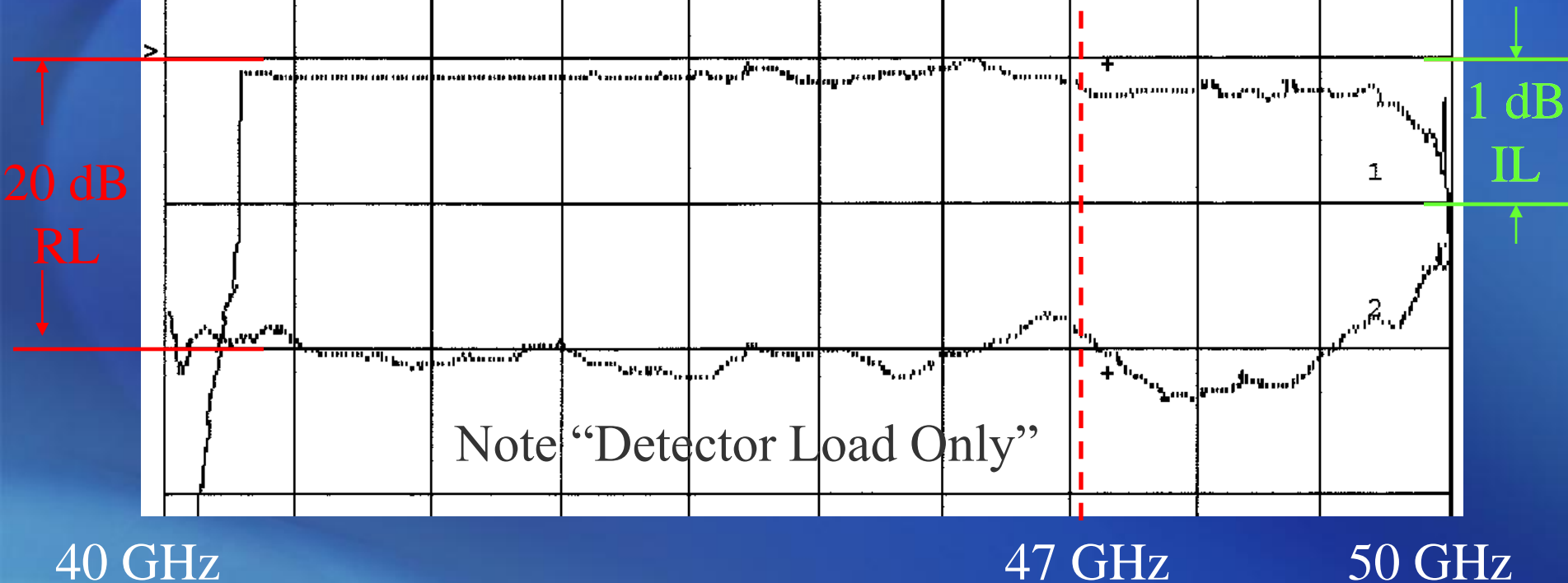


Test Results- “H” Plane Bend

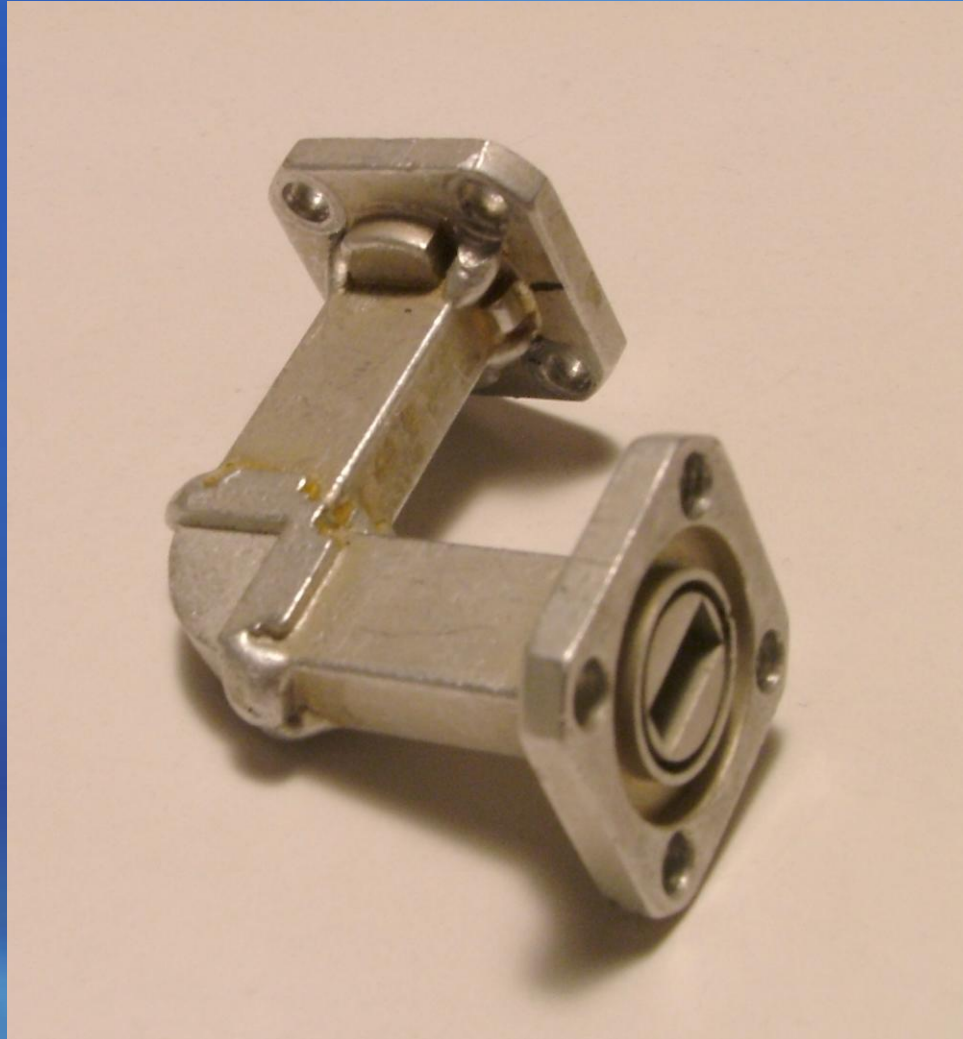
CH1: A -M S - 23.08 dB
10.0 dB/ REF - .00 dB

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

47 GHZ WR-28 TEST 90 DEG H BEND



Test Results- CAST “H” Plane Bend

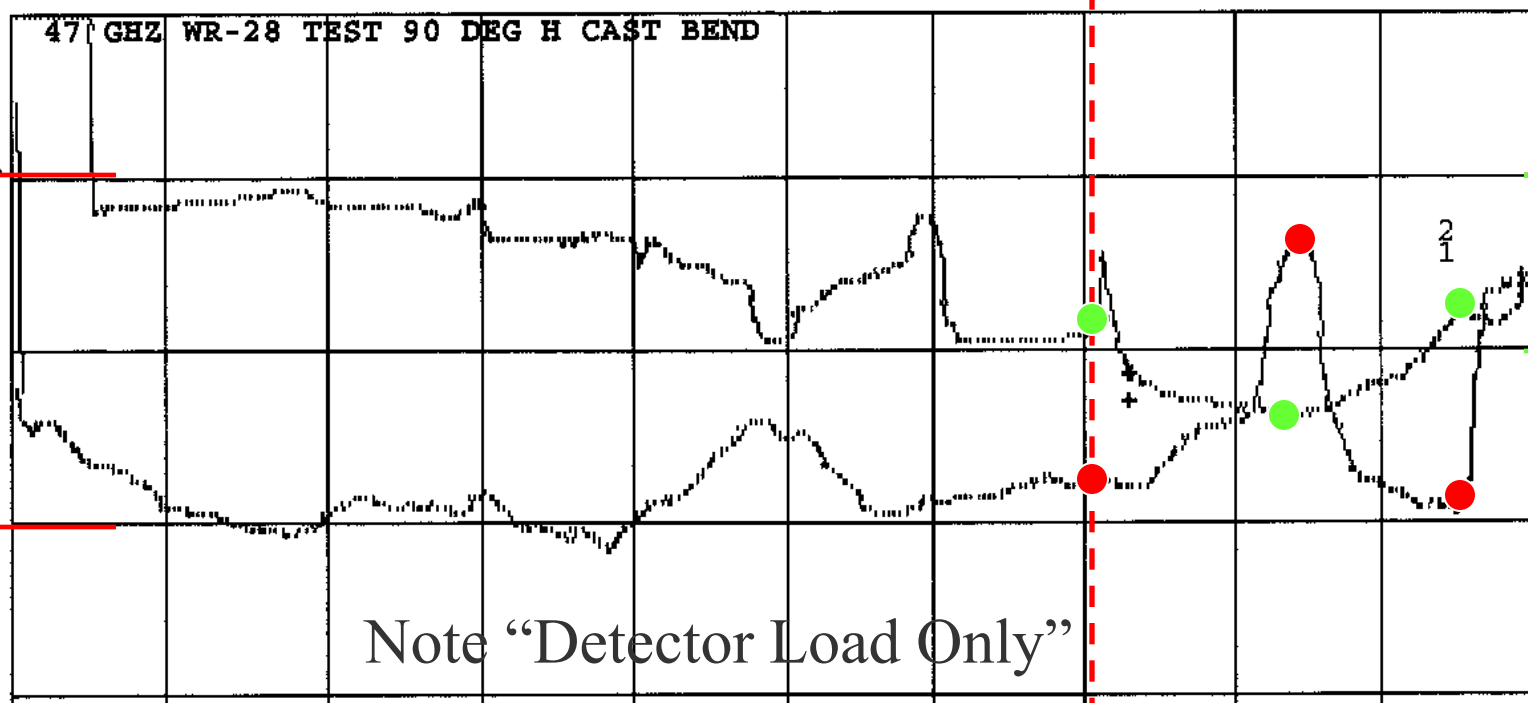


Test Results- CAST “H” Plane Bend

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

47 GHz WR-28 TEST 90 DEG H CAST BEND



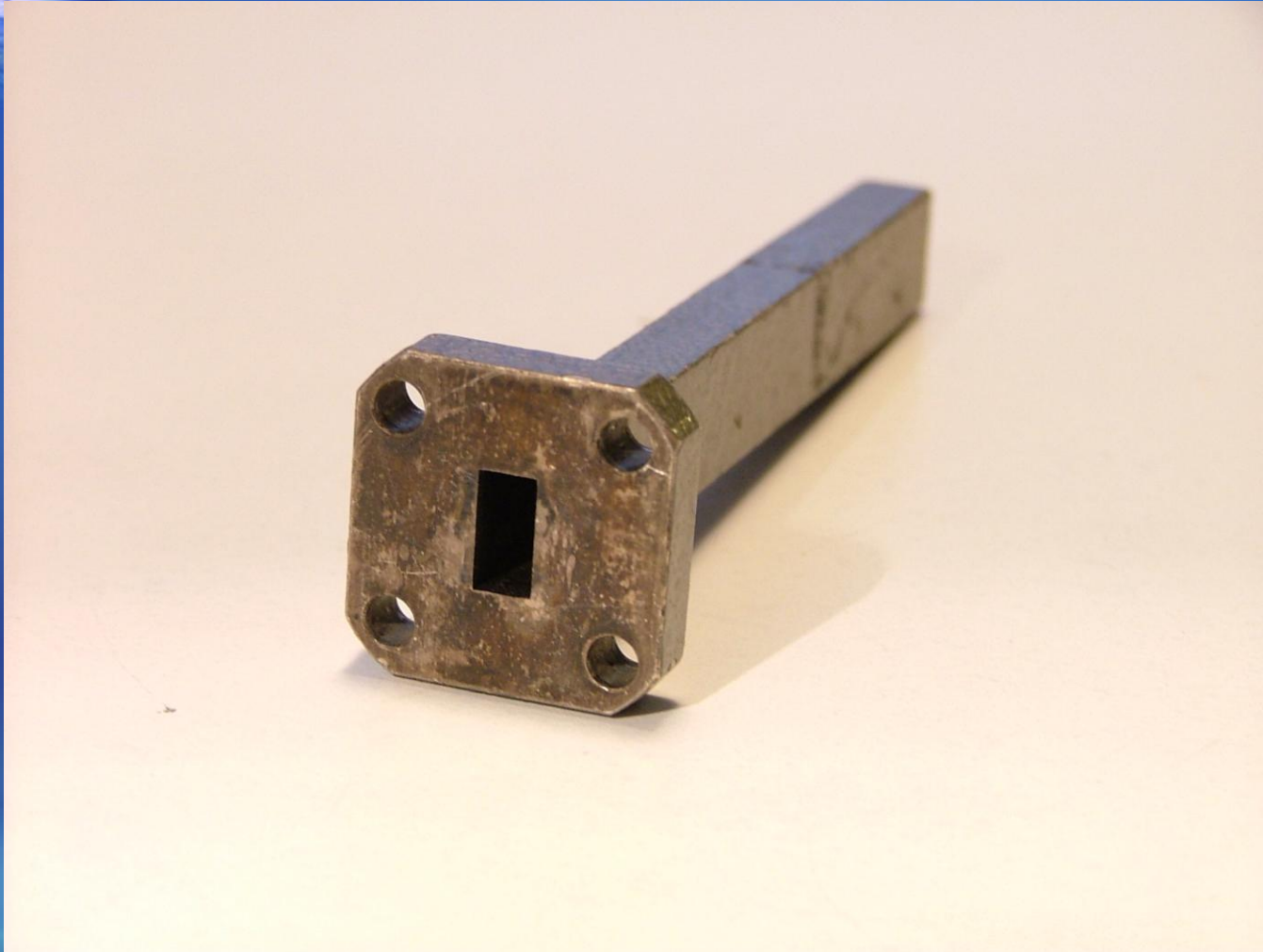
Note "Detector Load Only"

40 GHz

47 GHz

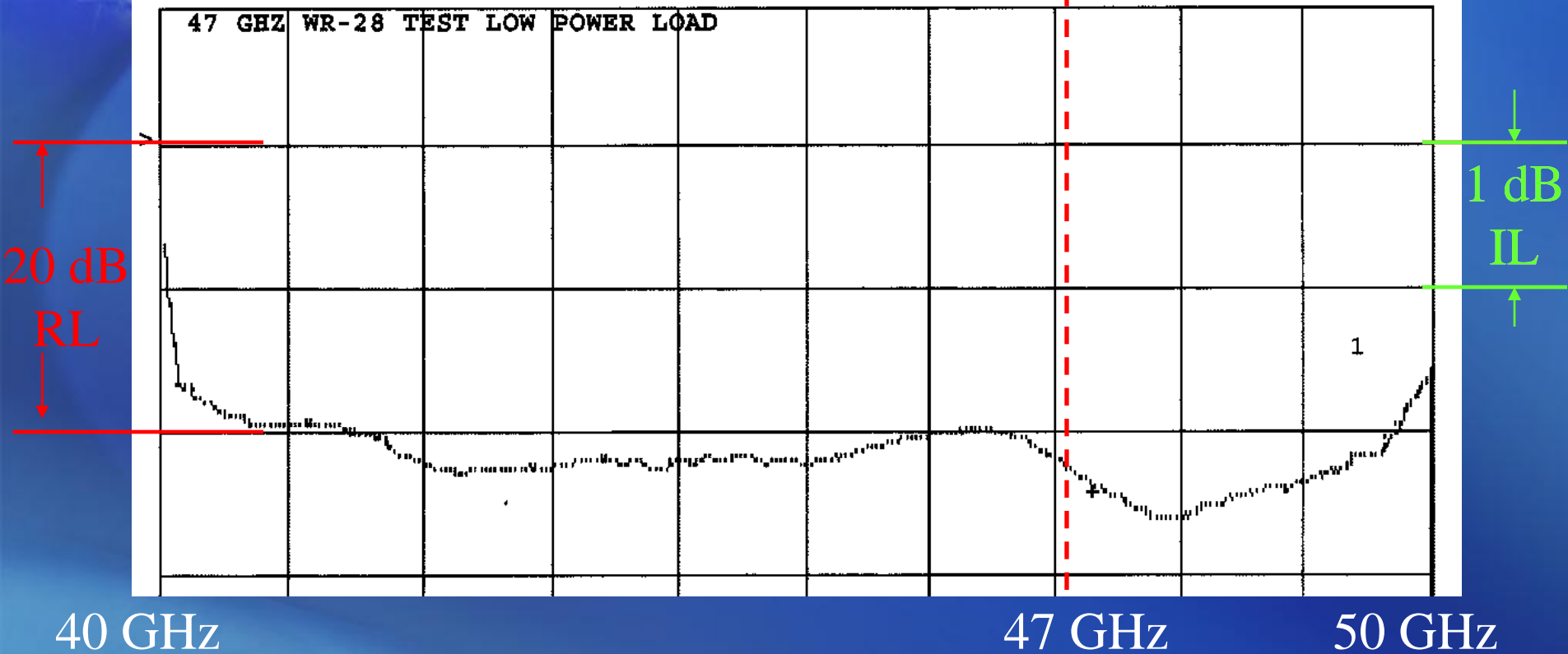
50 GHz

Test Results- Low Power Load

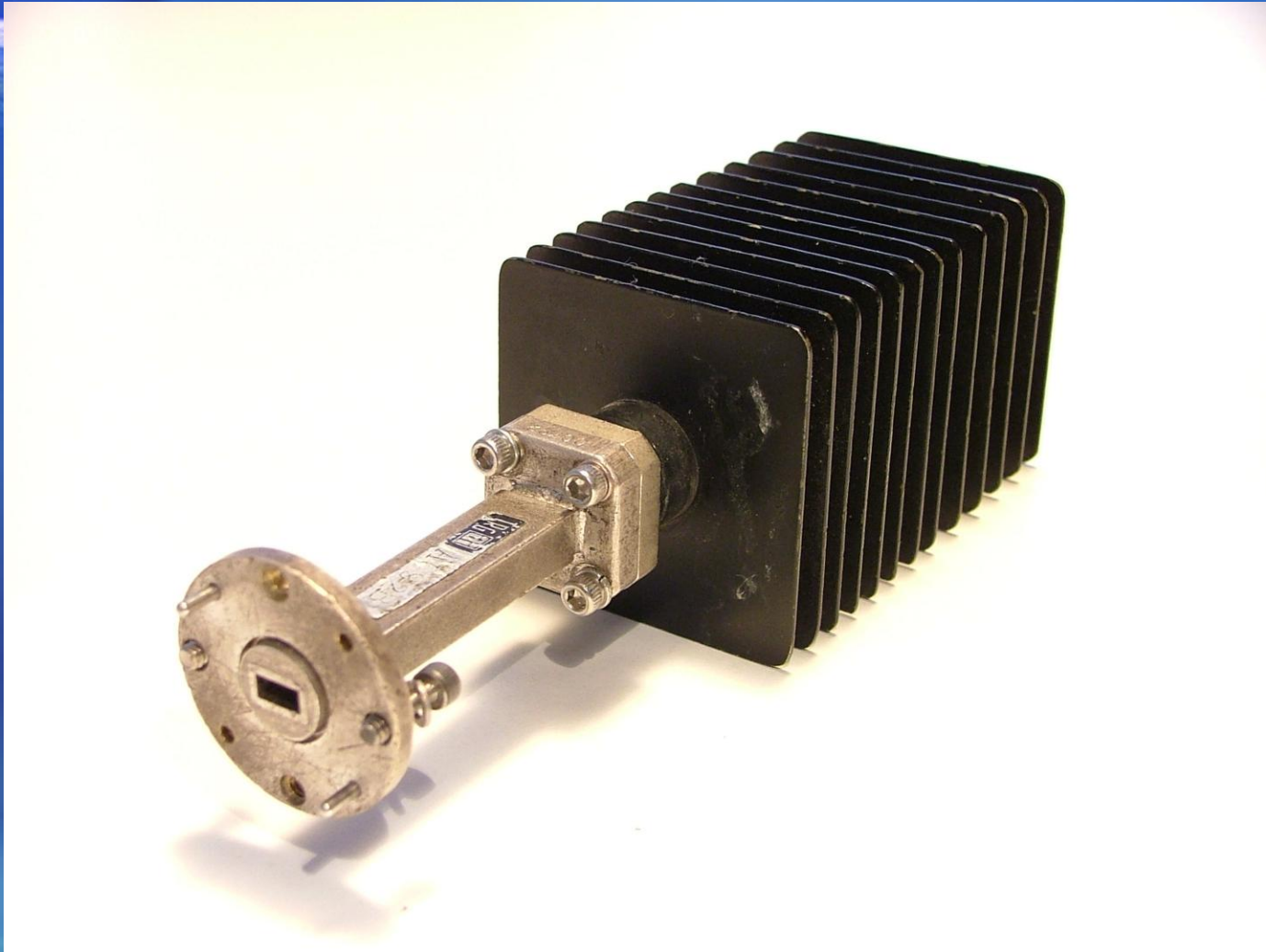


Test Results- Low Power Load

CH1: A -M S - 25.52 dB
10.0 dB/ REF - .00 dB

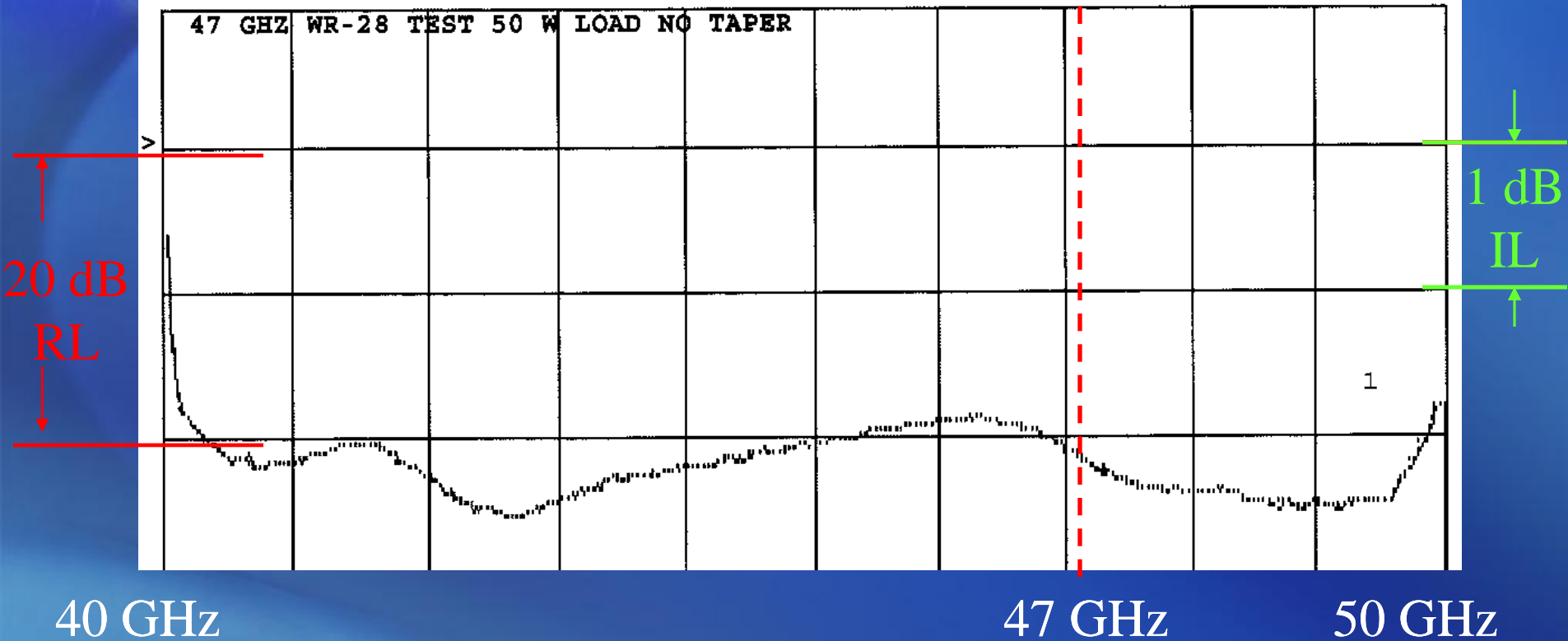


Test Results- High Power Load



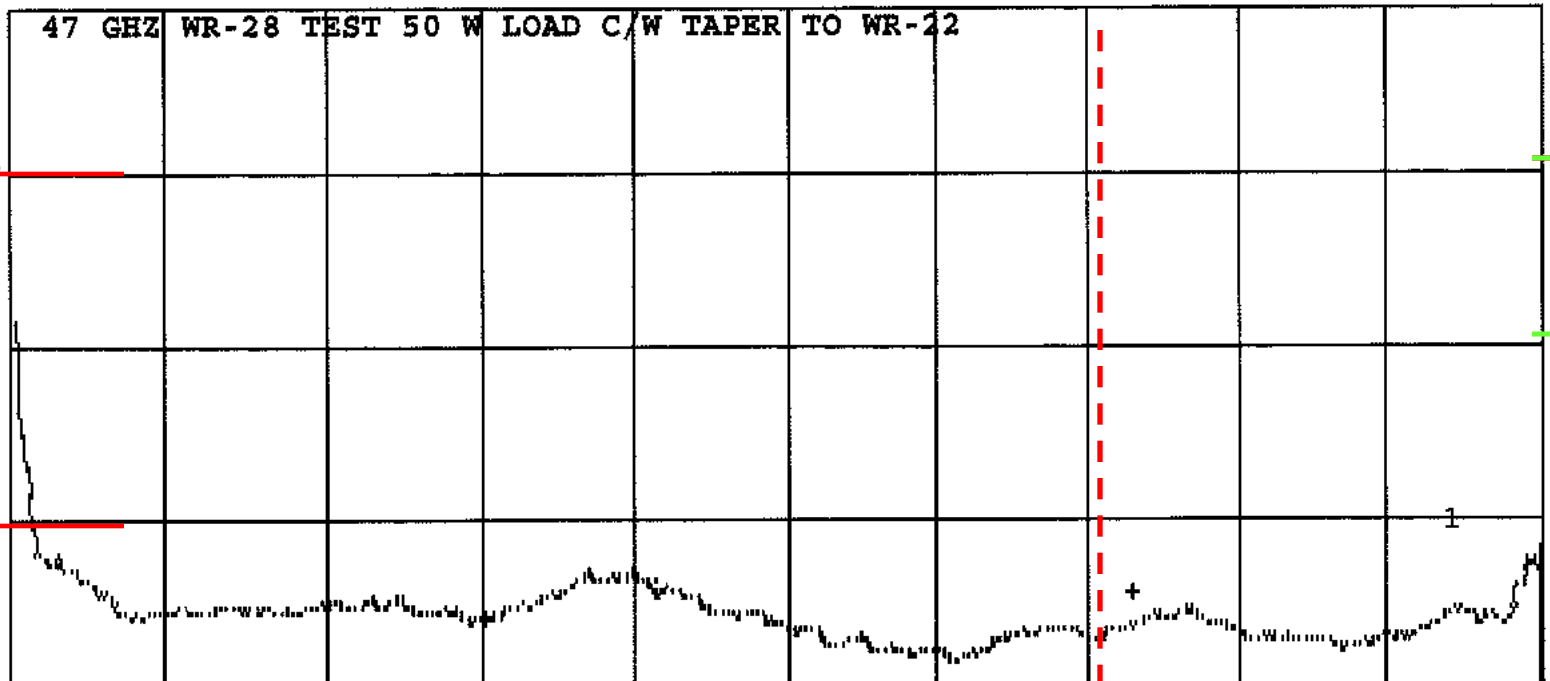
Test Results- High Power Load

CH1: A -M S - 23.54 dB
10.0 dB/ REF - .00 dB



High Power Load With Taper to WR22

CH1: A -M S - 25.80 dB
10.0 dB/ REF - .00 dB



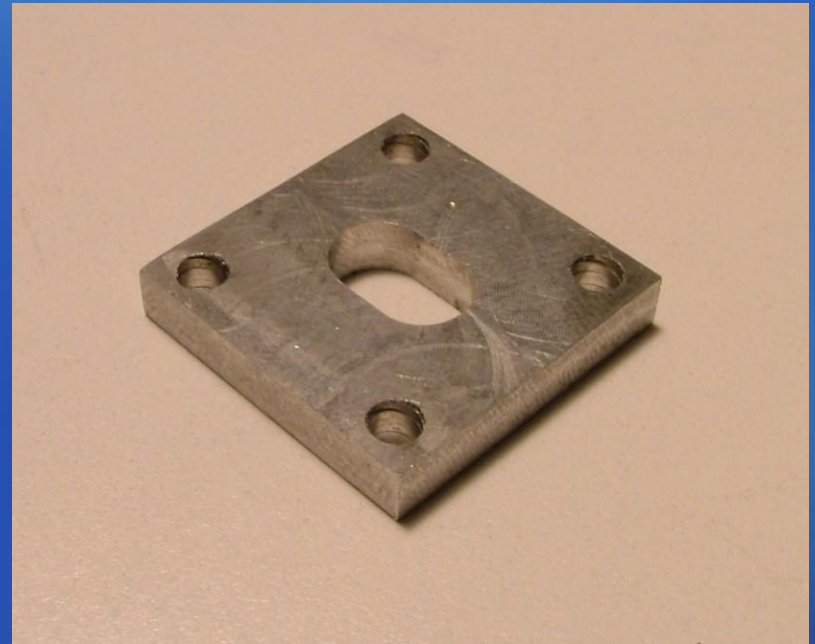
40 GHz

47 GHz

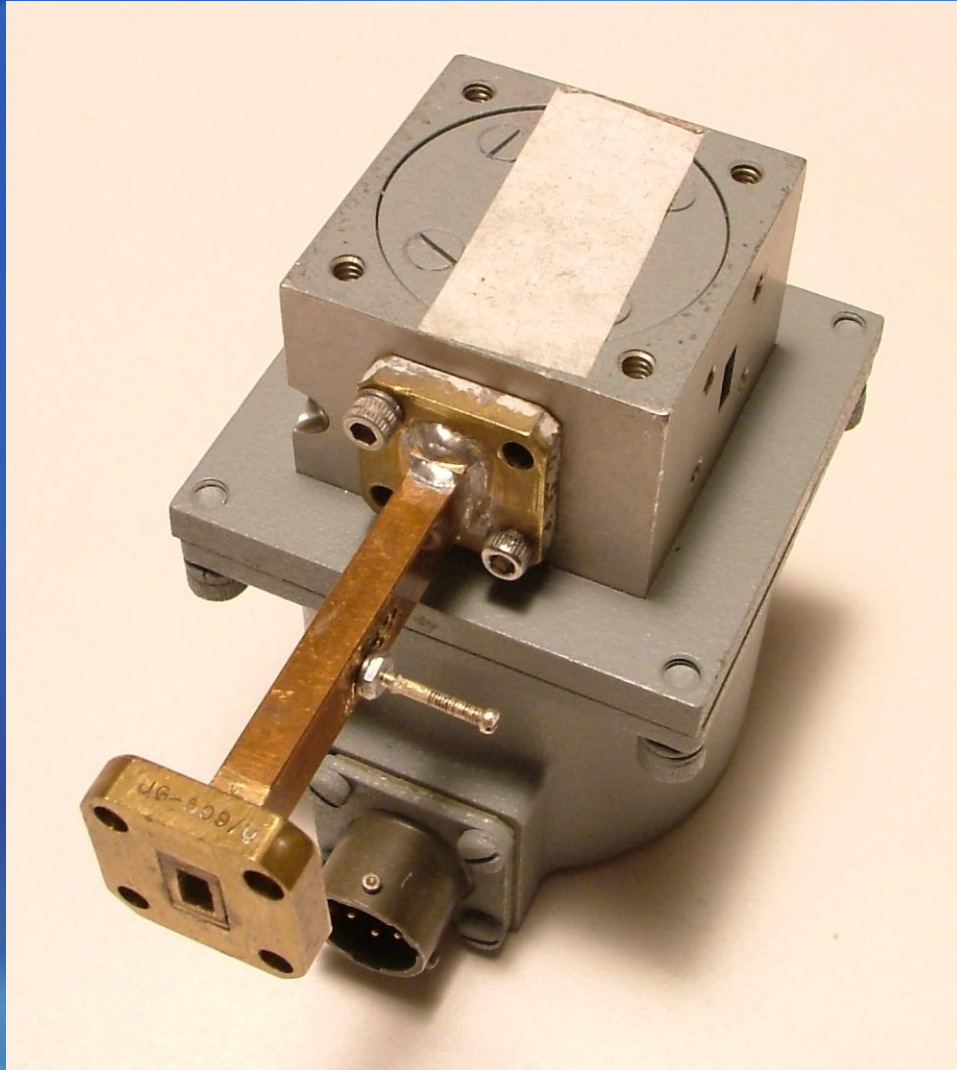
50 GHz

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



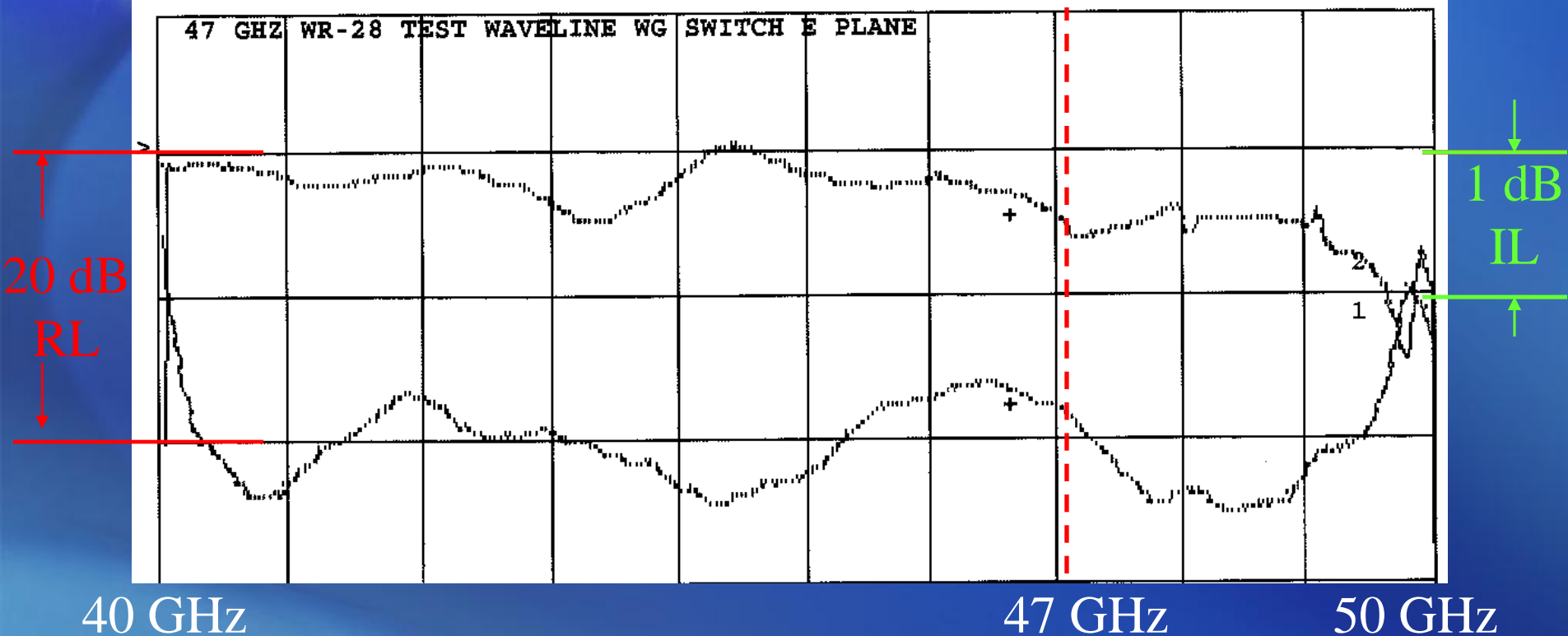
Waveline 1077 “E Plane” WG Switch



Waveline 1077 “E Plane” WG Switch

CH1: A -M S - 18.87 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - .57 dB
1.0 dB/ REF - .00 dB

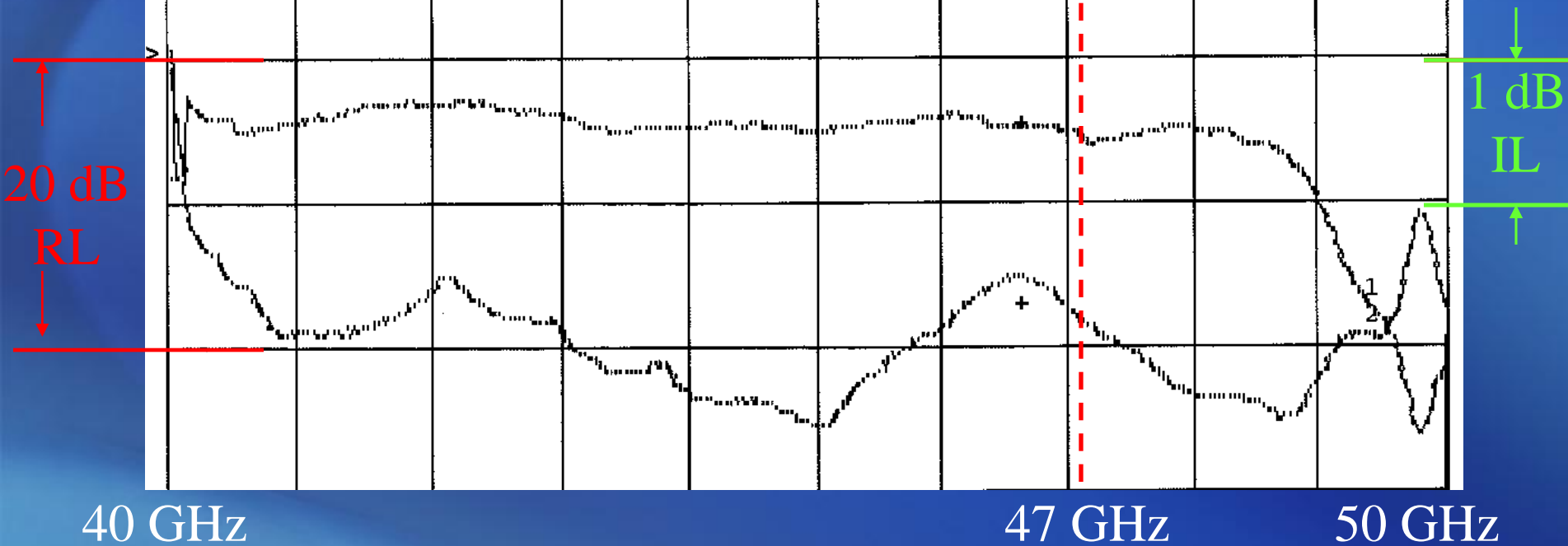


1077 “E Plane” WG Switch “Tuned”

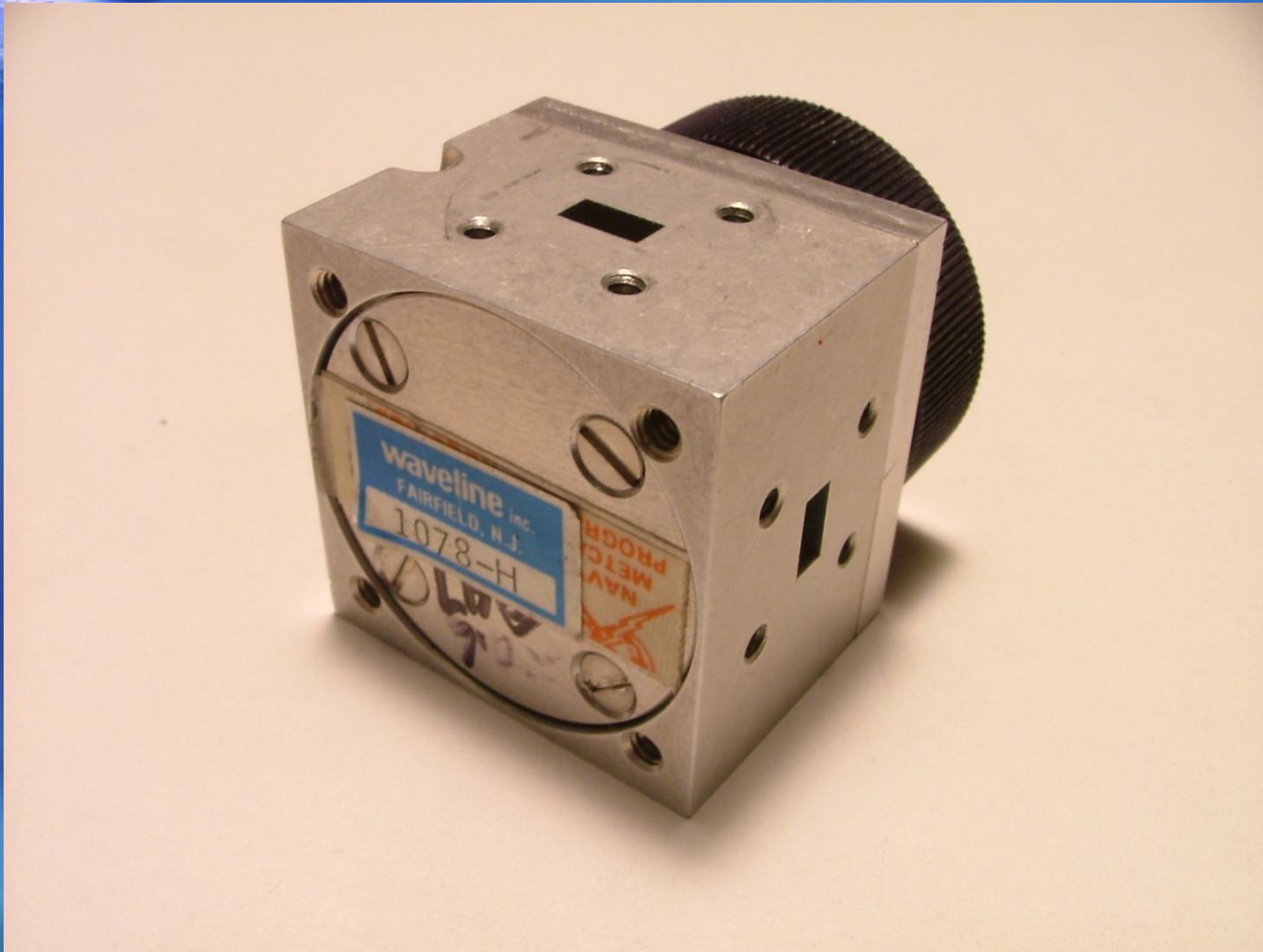
CH1: A -M S - 18.13 dB
10.0 dB/ REF - .00 dB

CH2: B -M S - ~~18.13~~ ^{5.5} dB
1.0 dB/ REF - .00 dB

47 GHZ WR-28 TEST WAVELINE WG SWITCH E PLANE TUNED



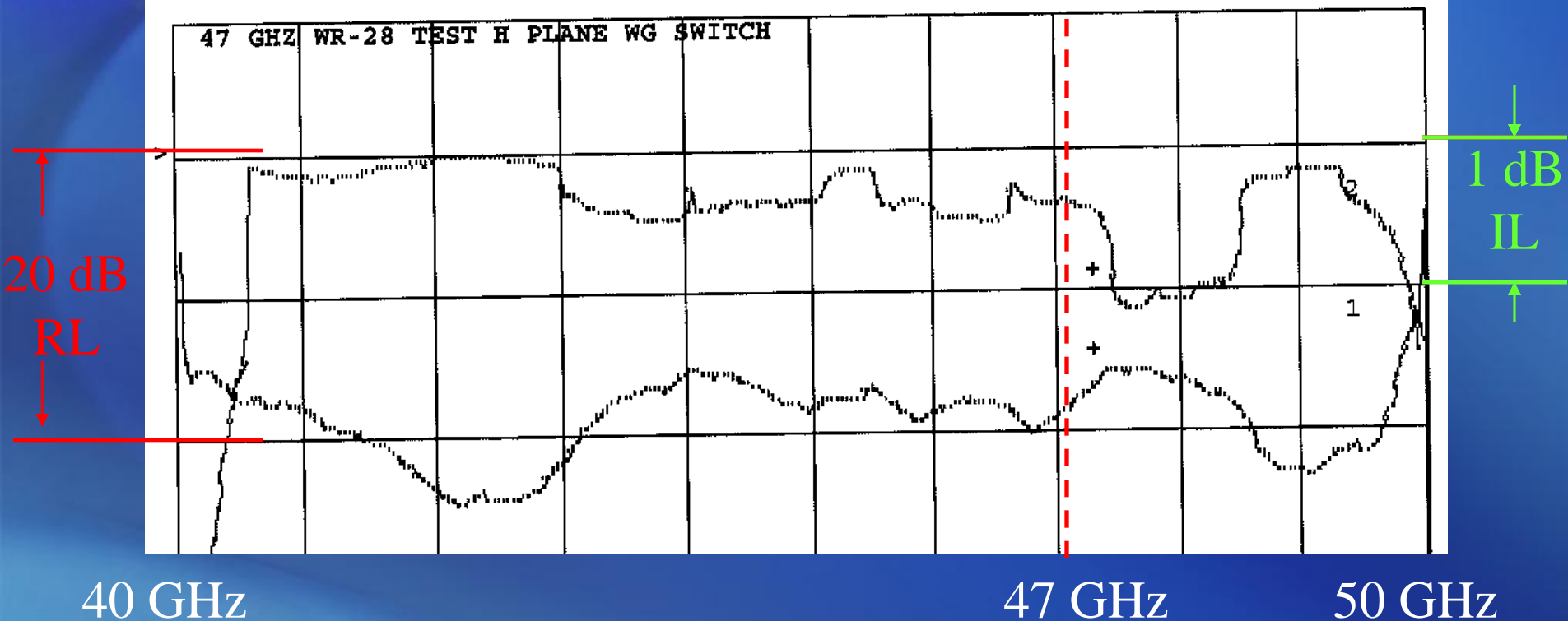
Waveline 1078 “H Plane” WG Switch



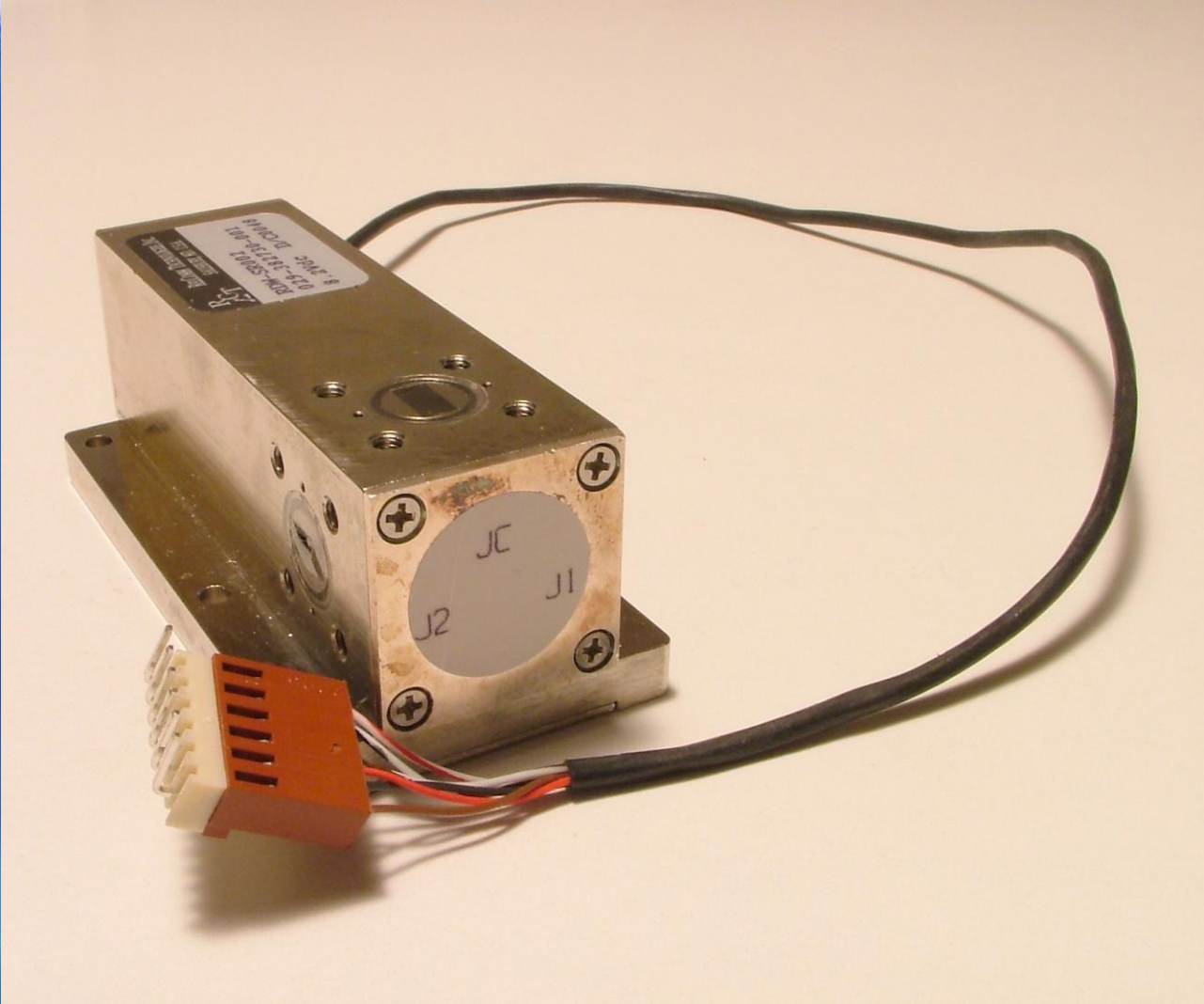
Waveline 1078 “H Plane” WG Switch

CH1: A -M S - 15.85 dB
10.0 dB/ REF - .00 dB

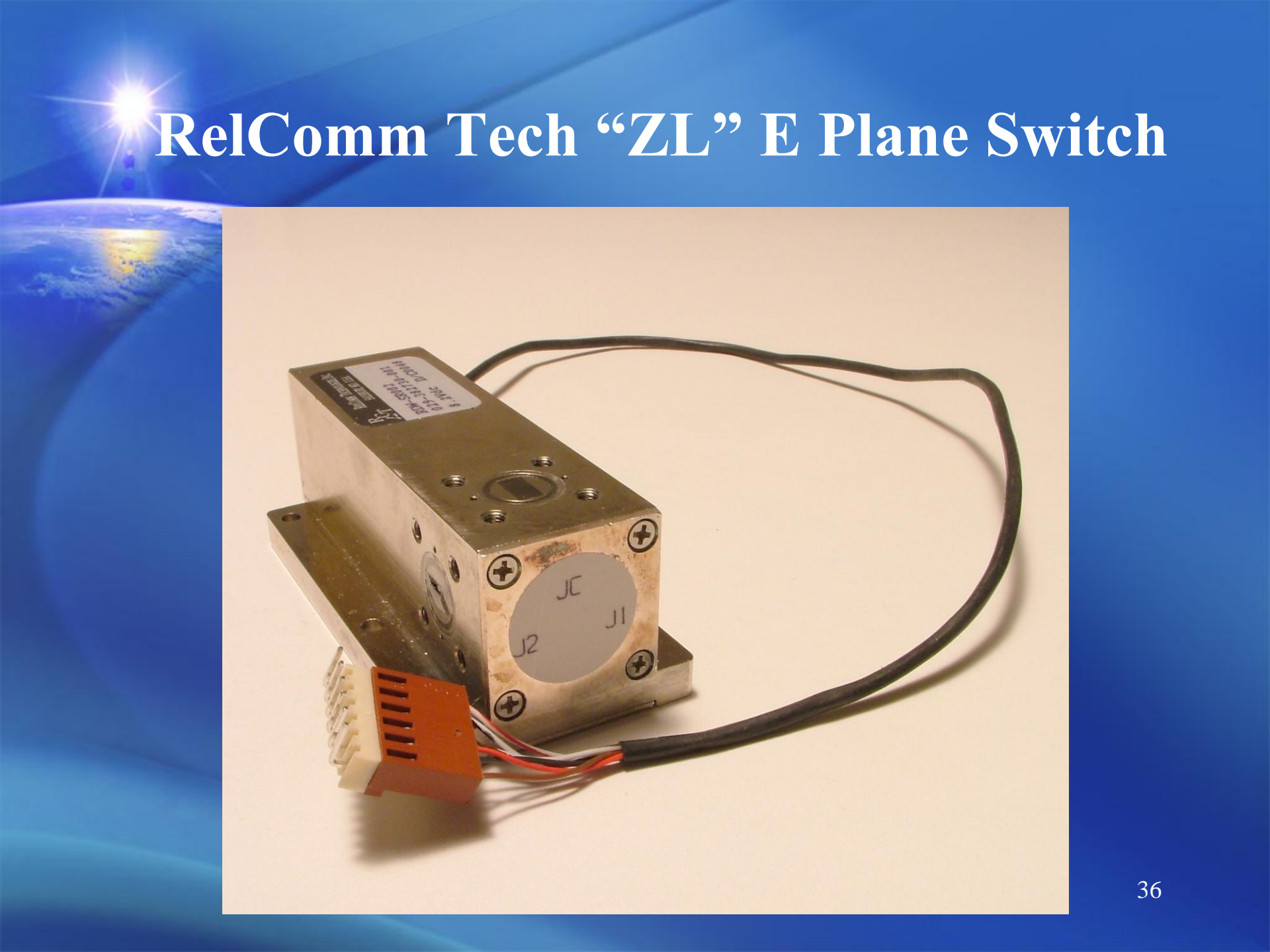
CH2: B -M S - 1.00 dB
1.0 dB/ REF - .00 dB



RelComm Tech “ZL” E Plane Switch



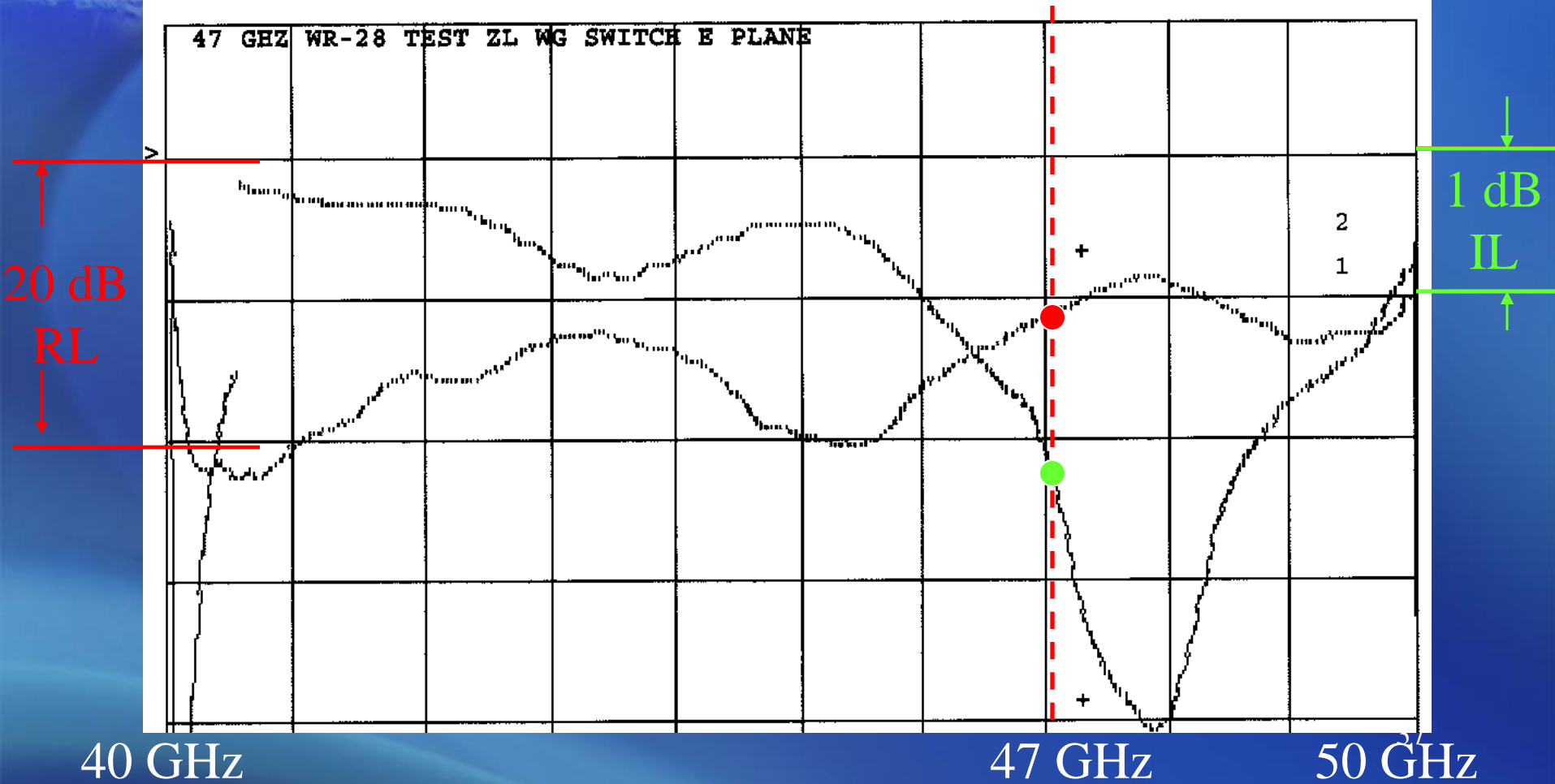
36



RelComm Tech “ZL” E Plane Switch

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

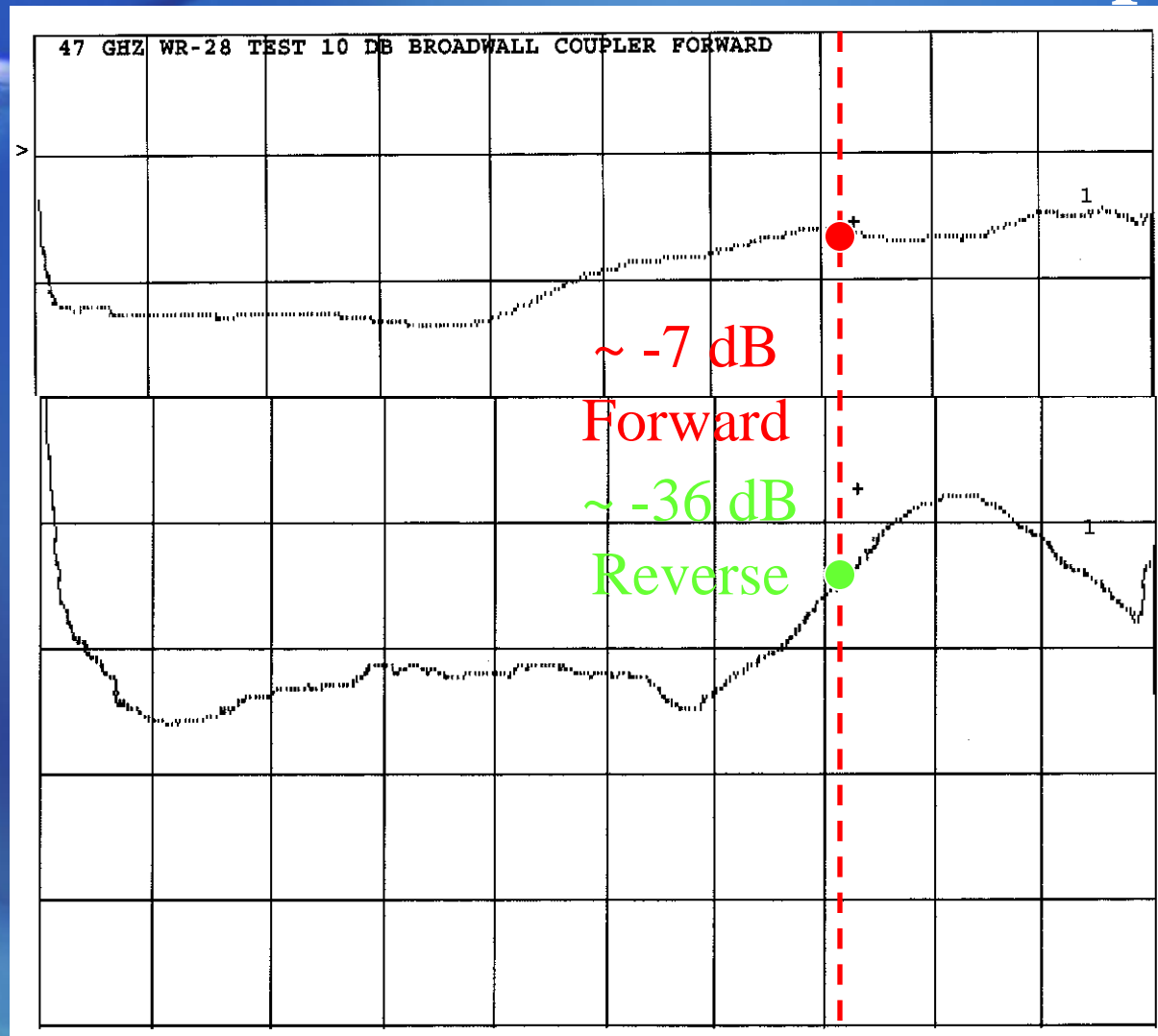
CH2: B -M S - 4.01 dB
1.0 dB/ REF - .00 dB



MCS R382-B Broadwall Coupler



MCS R382-B Broadwall Coupler



40 GHz

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50 GHz



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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- Questions?