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

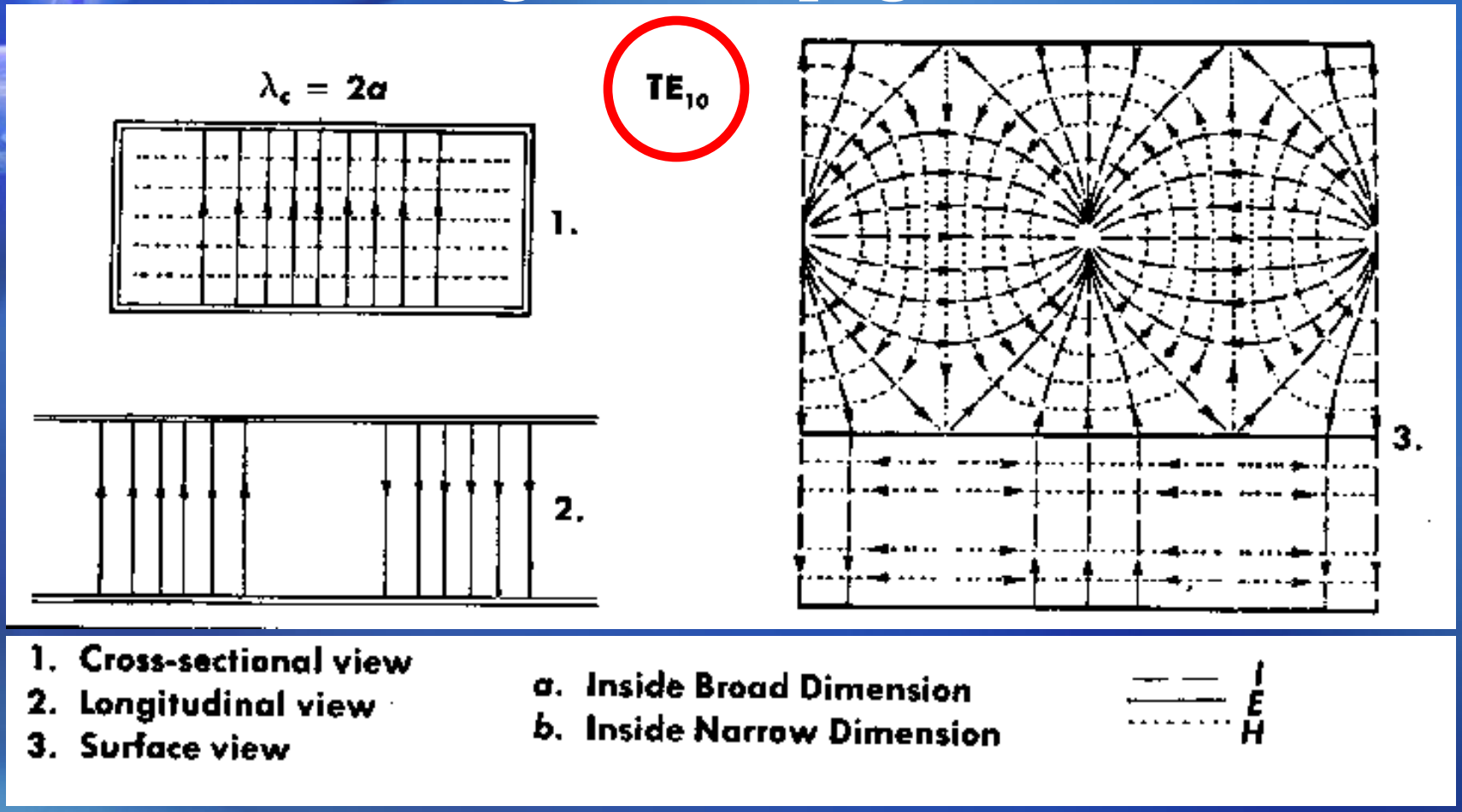
Significance of WR28 Use on 47 GHz?

- **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

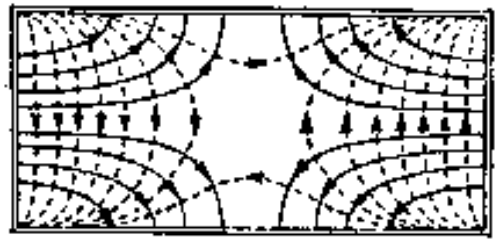


Cutoff Wavelength = 21.1 GHz

Waveguide Propagation Modes

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

TE_{11}



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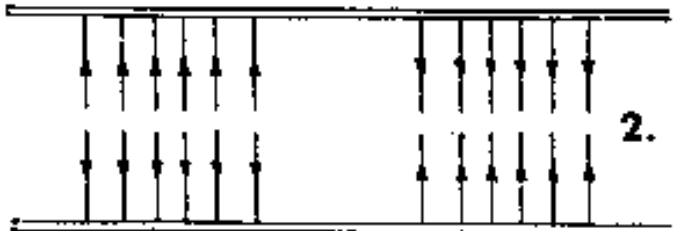

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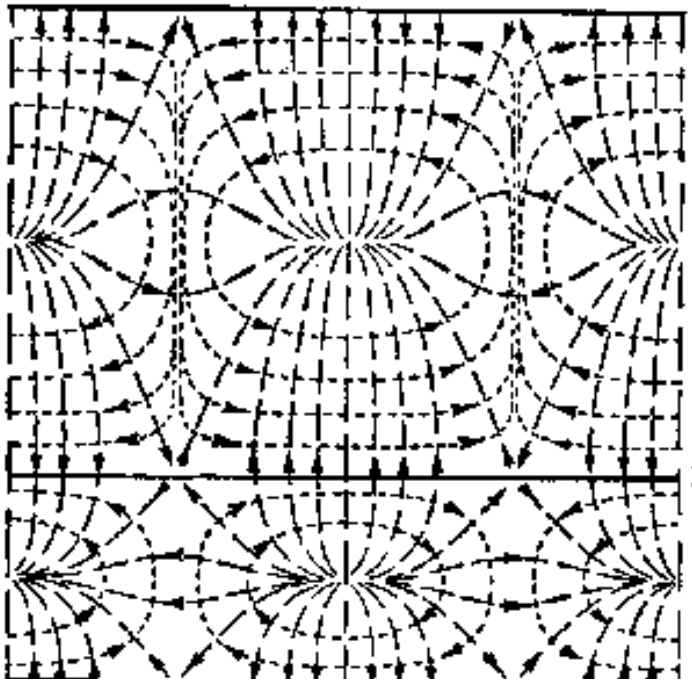
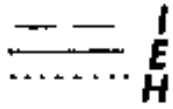


3.

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

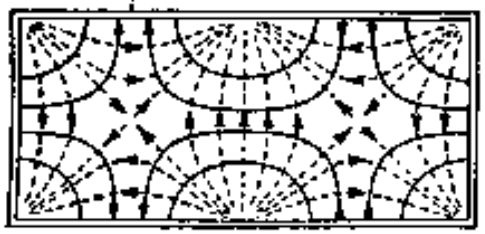
a. Inside Broad Dimension
b. Inside Narrow Dimension



Cutoff Wavelength = 47.2 GHz

Waveguide Propagation Modes

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



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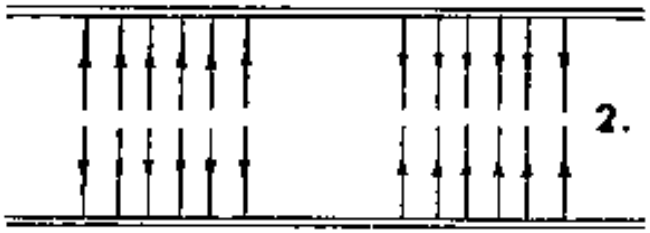
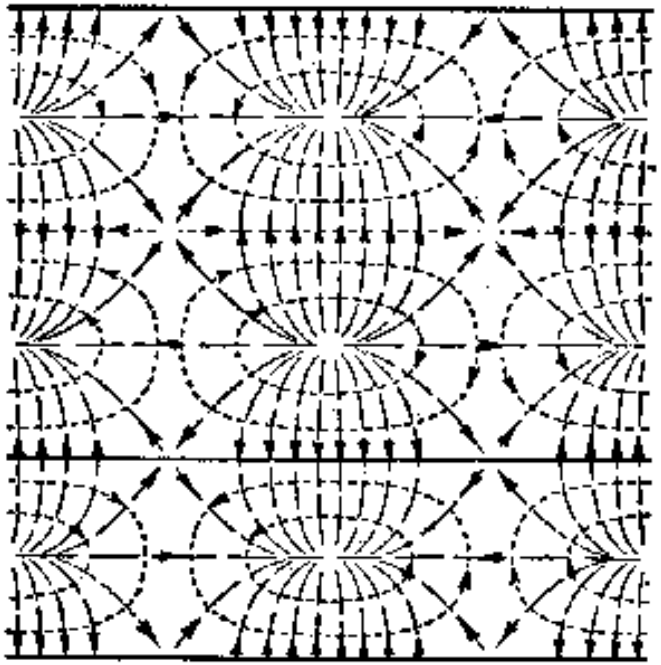


2.

TE_{21}



3.

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

a. Inside Broad Dimension
b. Inside Narrow Dimension

I
E
H

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

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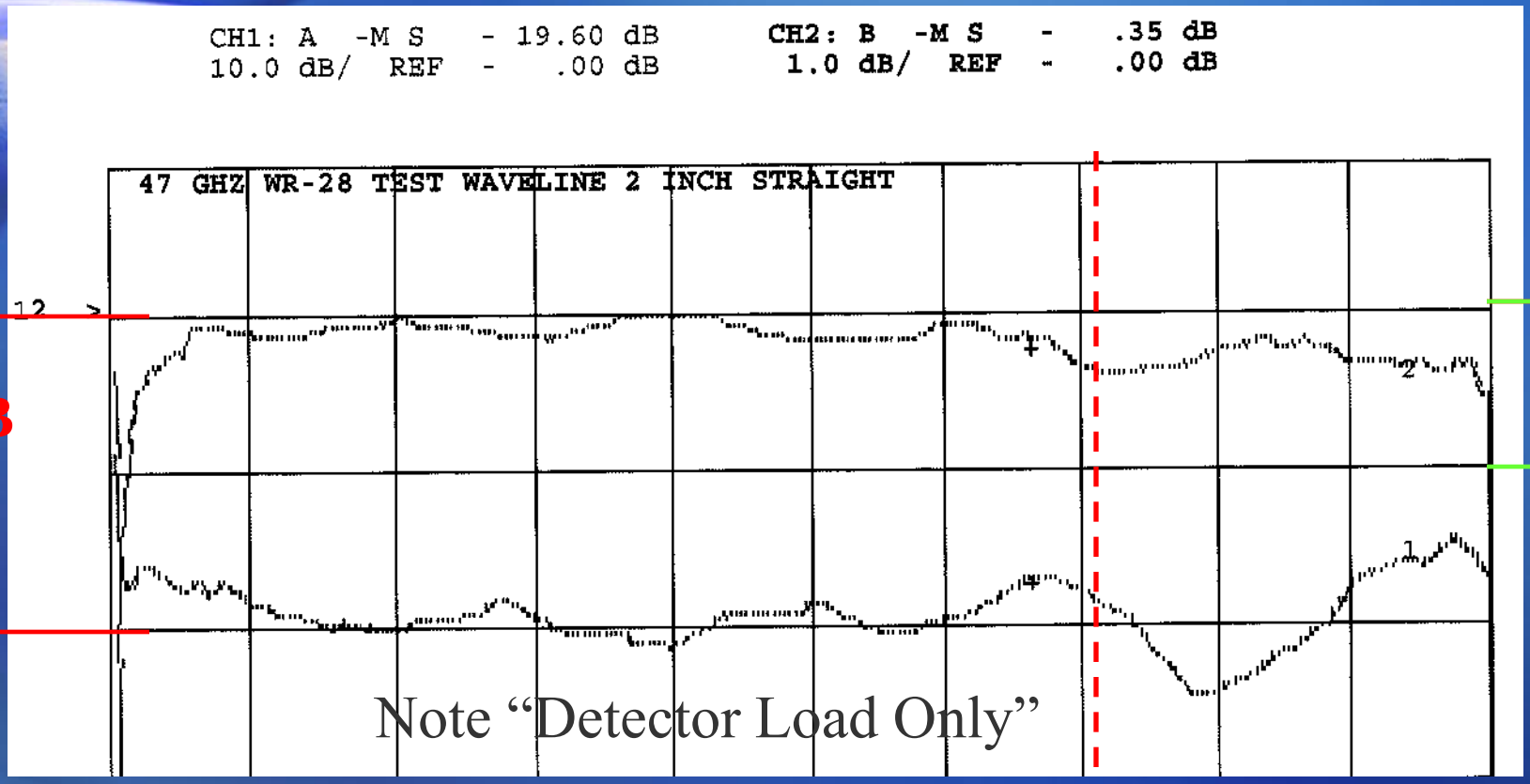


20 dB RL

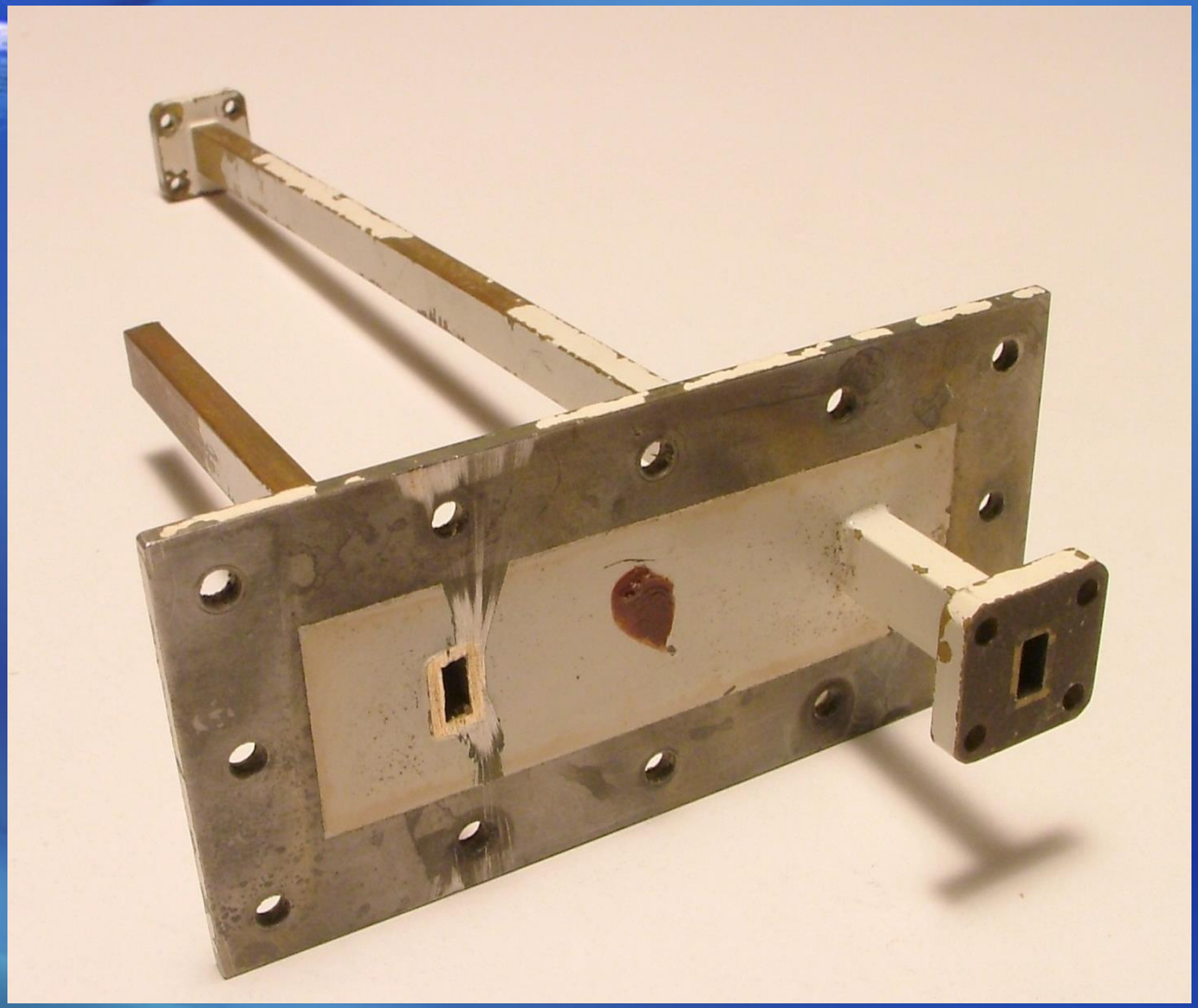
1 dB IL

40 GHz

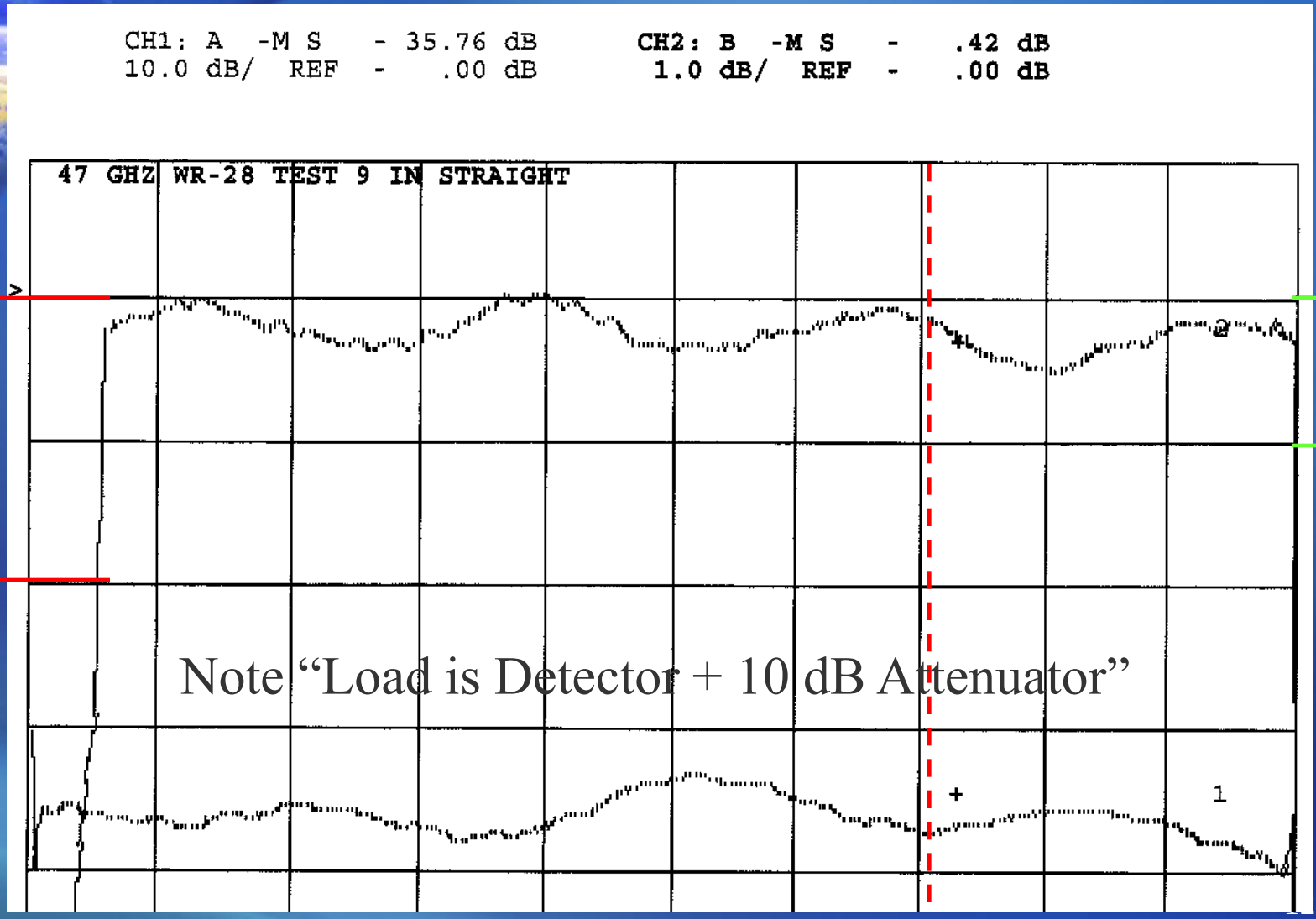
47 GHz

50 GHz

Test Results- “9 Inch” Straight WG



Test Results- “9 Inch” Straight WG



20 dB RL

1 dB IL

40 GHz 47 GHz 50 GHz

Test Results- “4 Inch” FLEX WG

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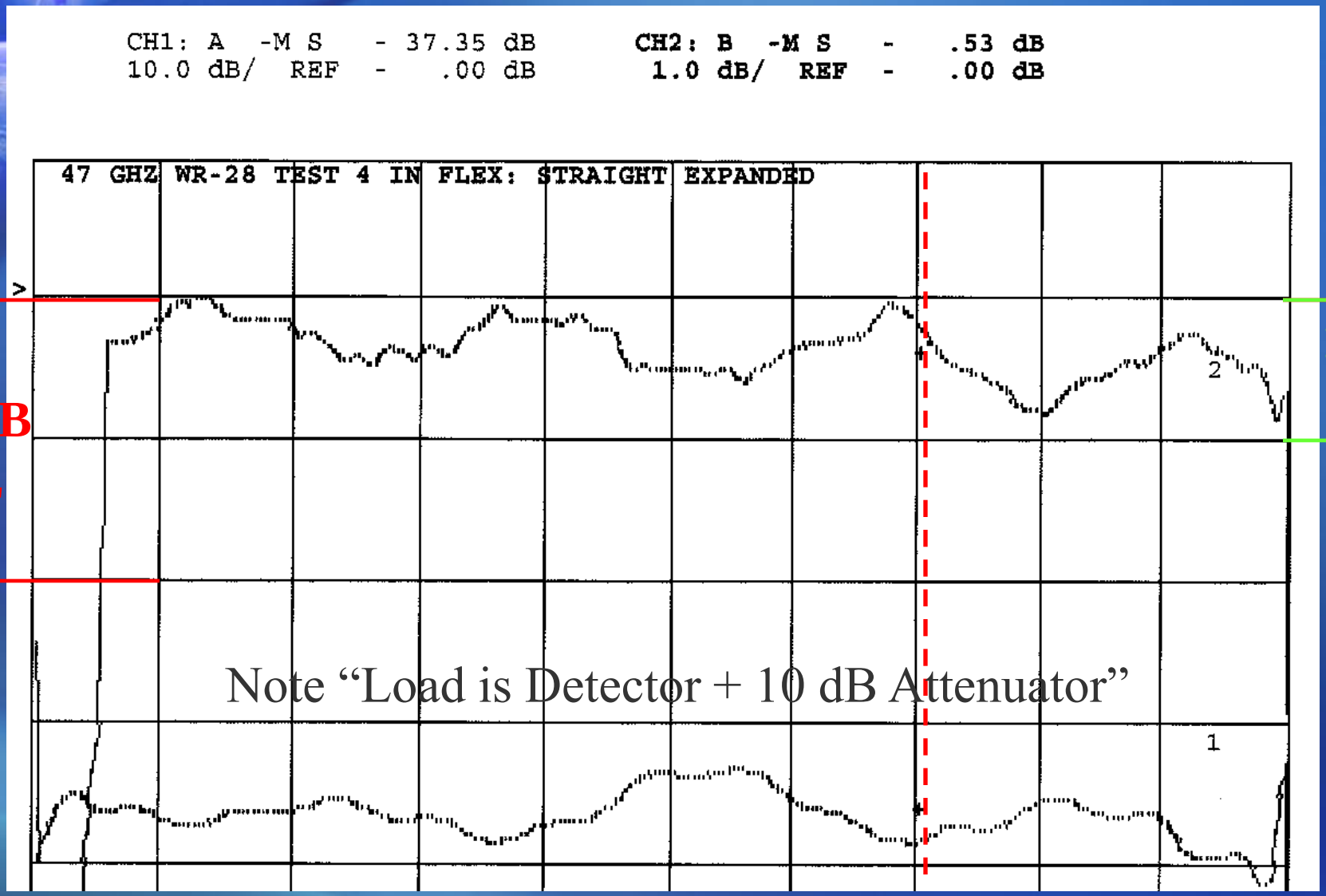

Test Results- “39 GHz Dish” FLEX

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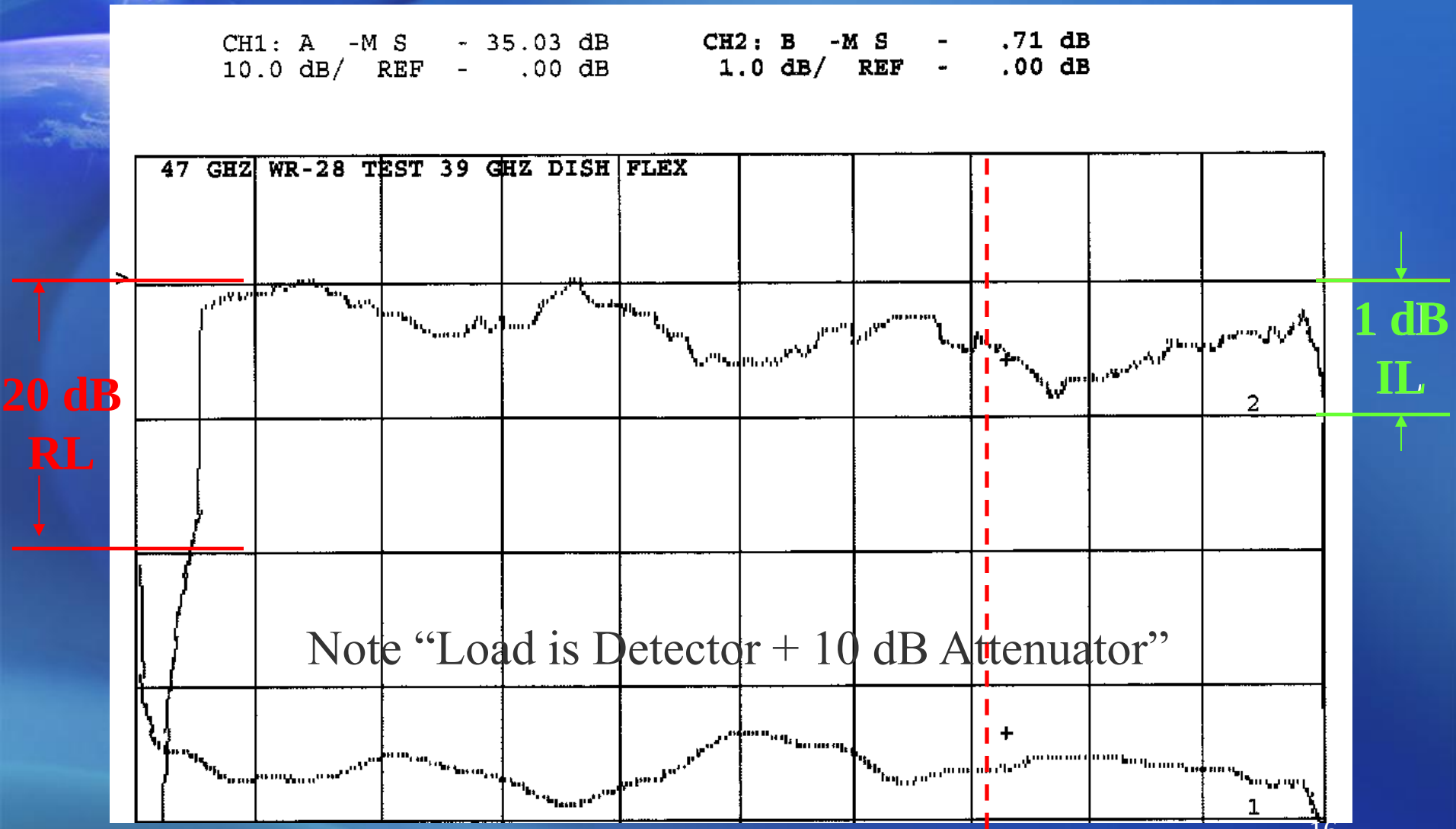

Test Results- “E” Plane Bend

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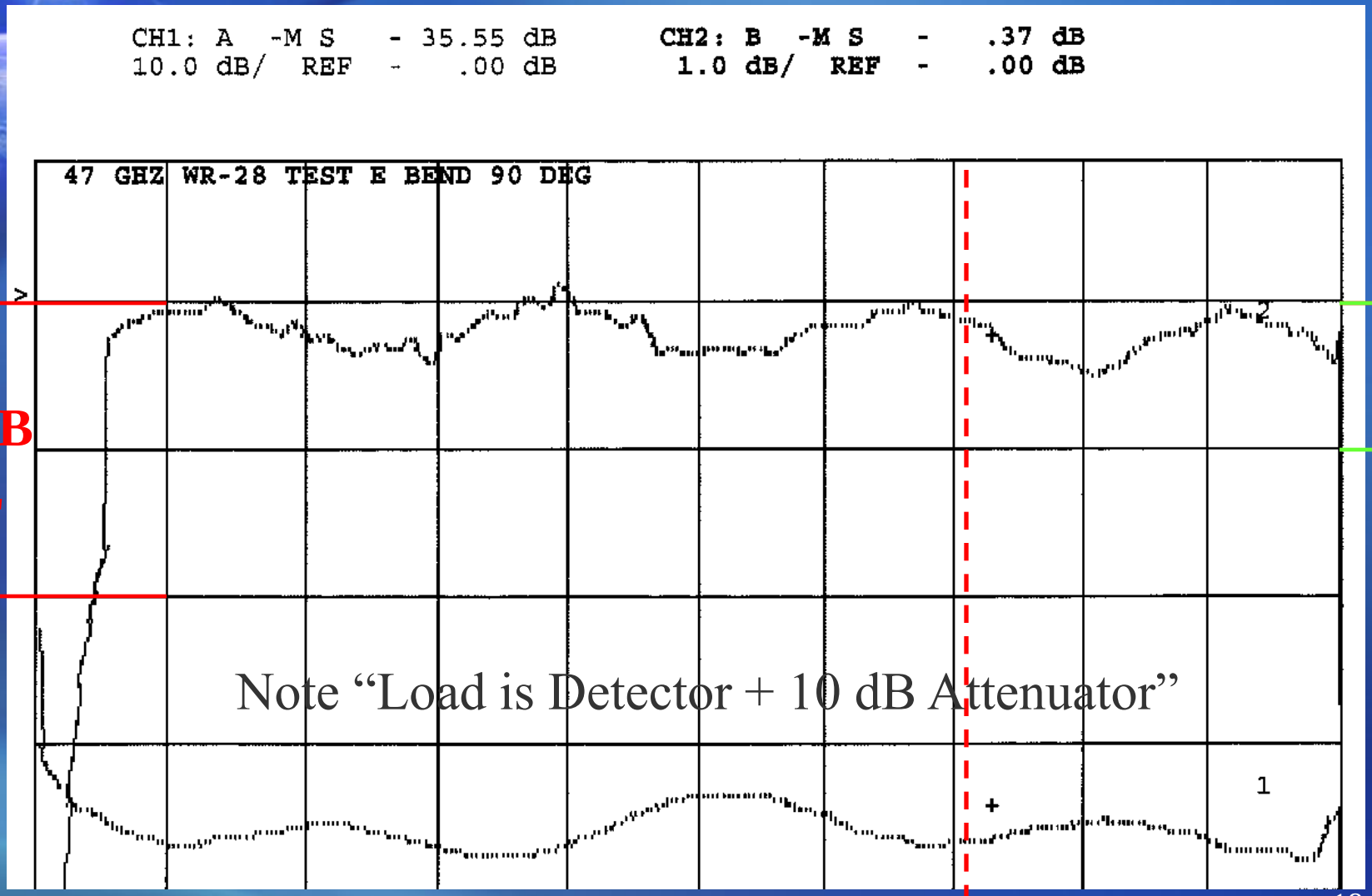

Test Results- “E” Plane Bend + TWIST

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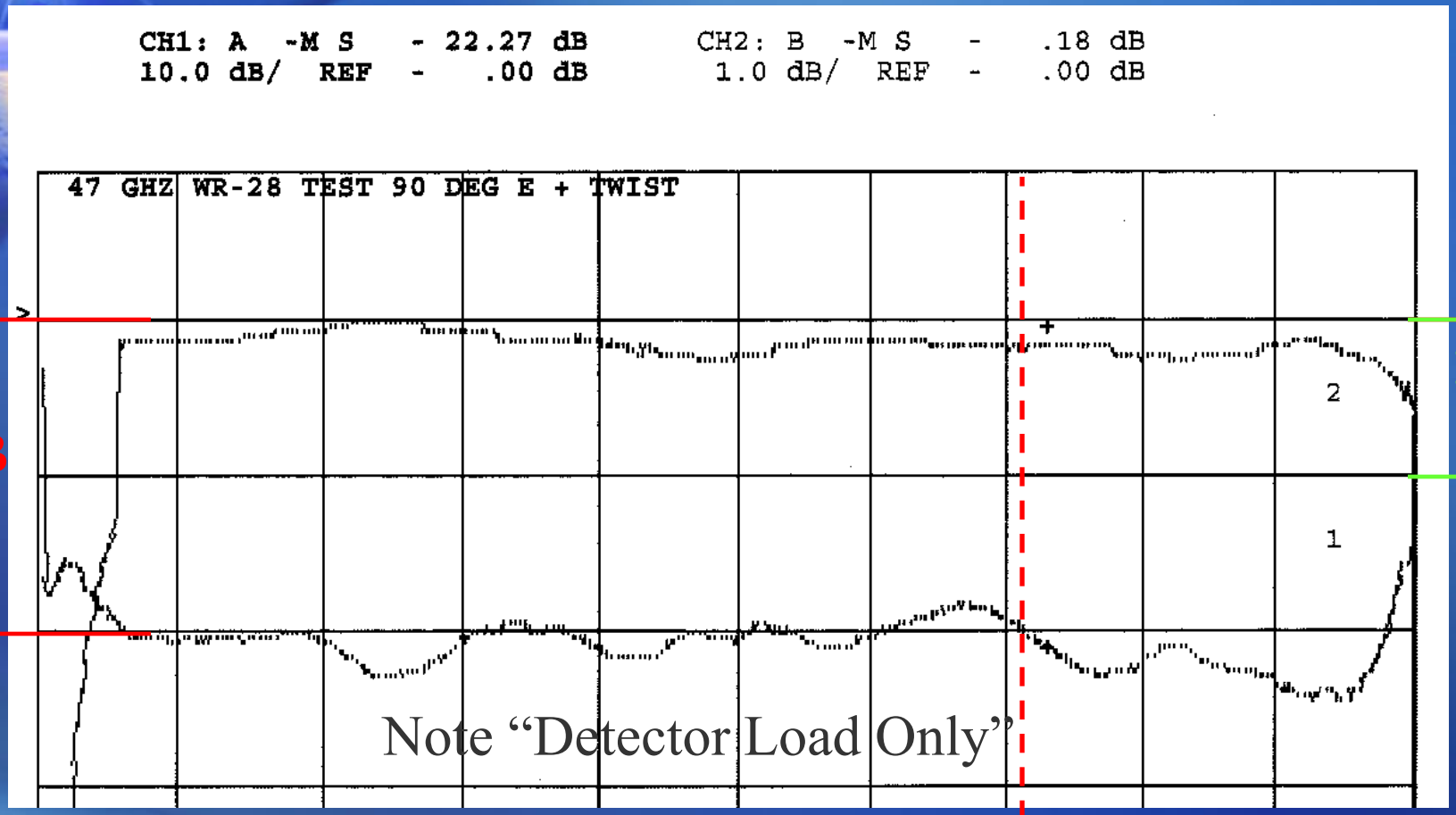

20 dB RL

1 dB IL

40 GHz

47 GHz

50 GHz

Test Results- “H” Plane Bend

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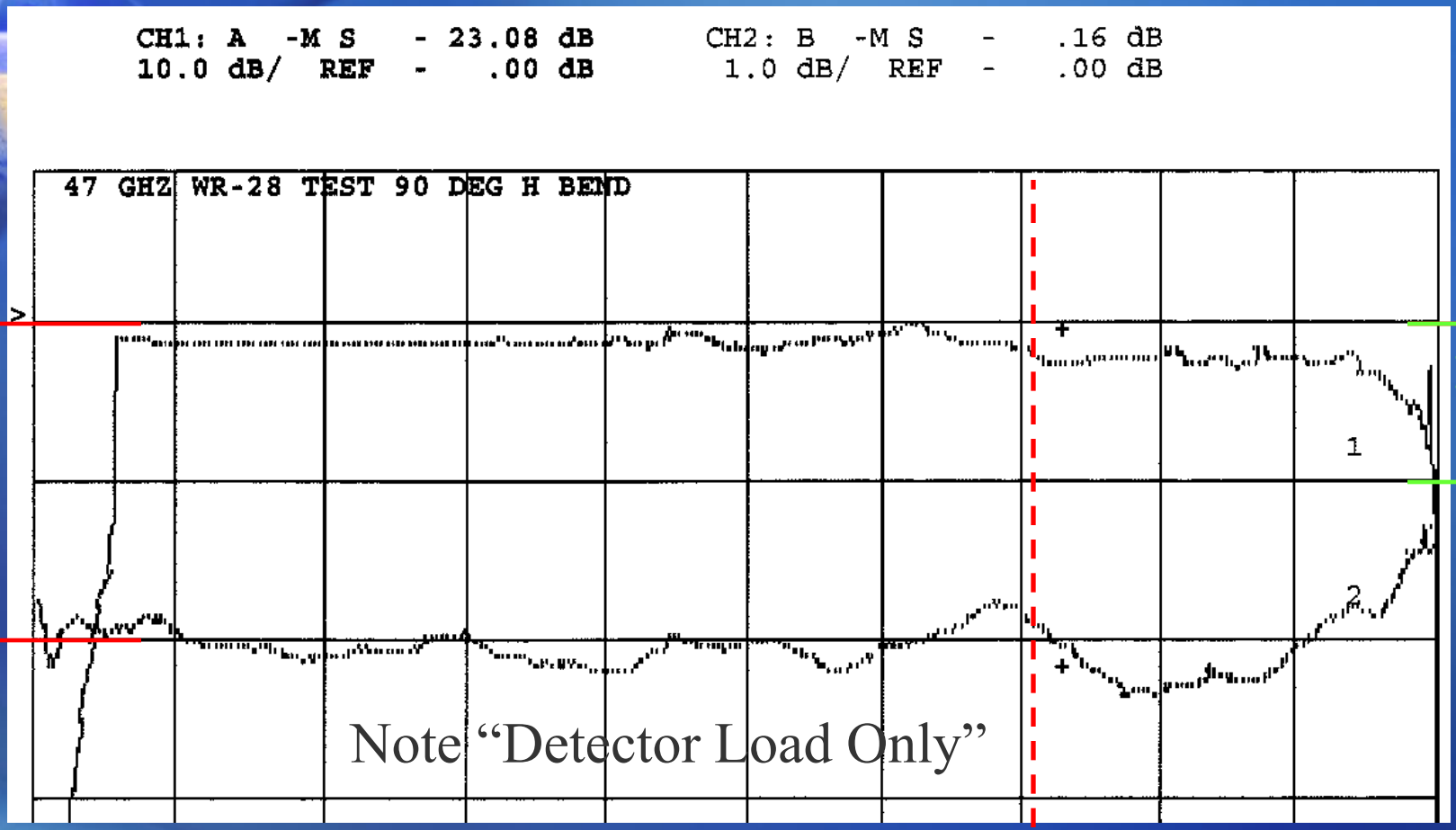

20 dB RL

1 dB IL

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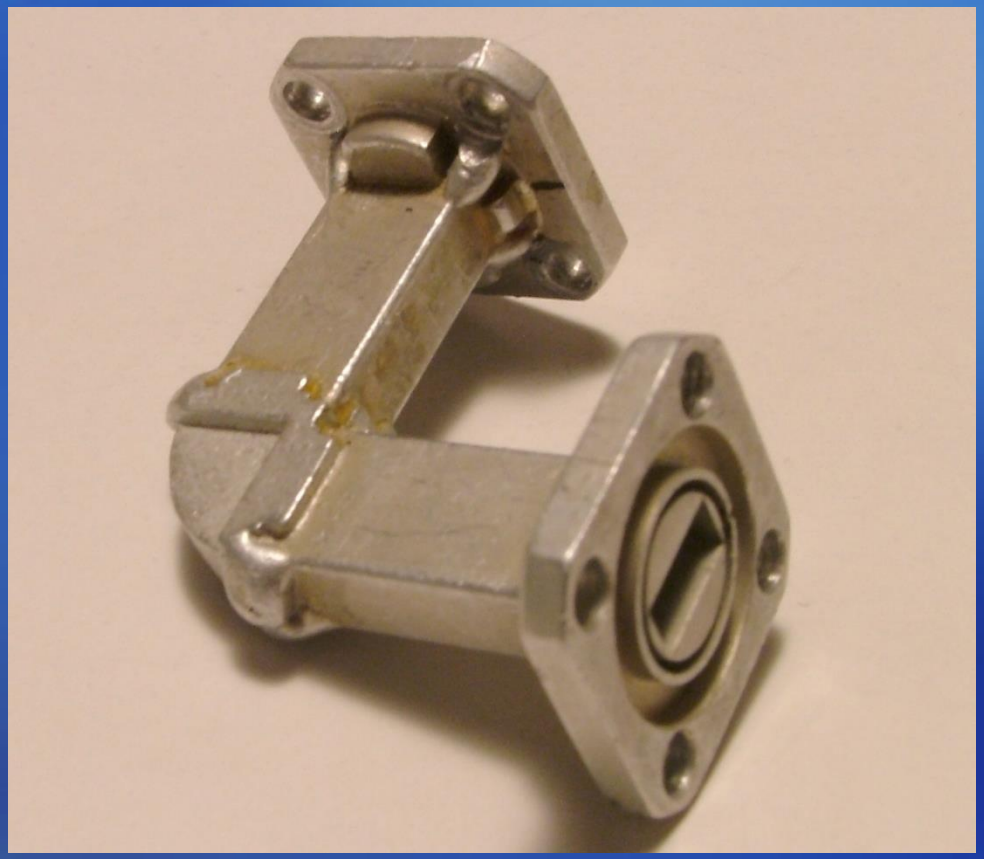
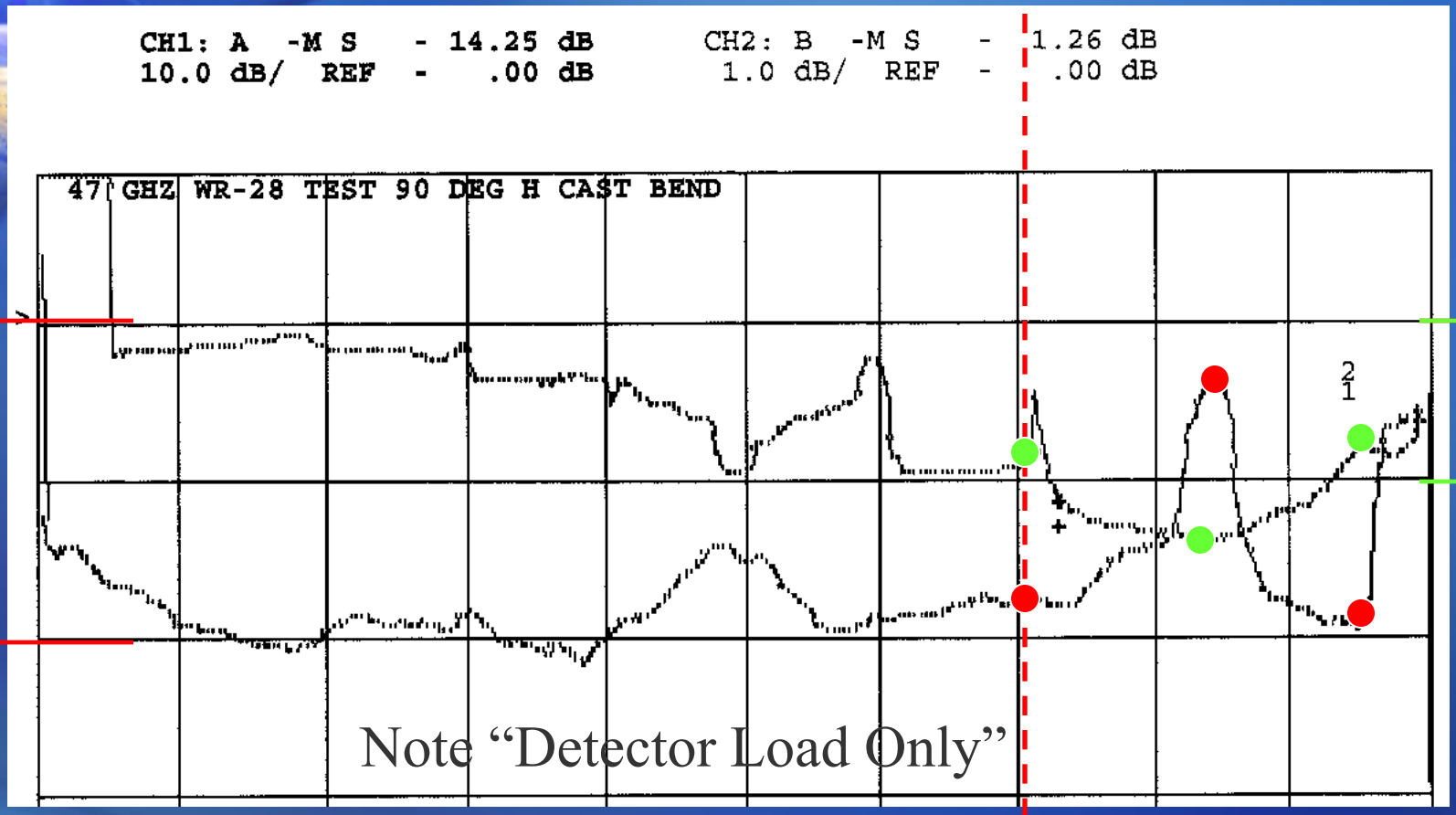
Test Results- CAST “H” Plane Bend



- **Note the Choked Flange**

Test Results- CAST "H" Plane Bend



20 dB RL

1 dB IL

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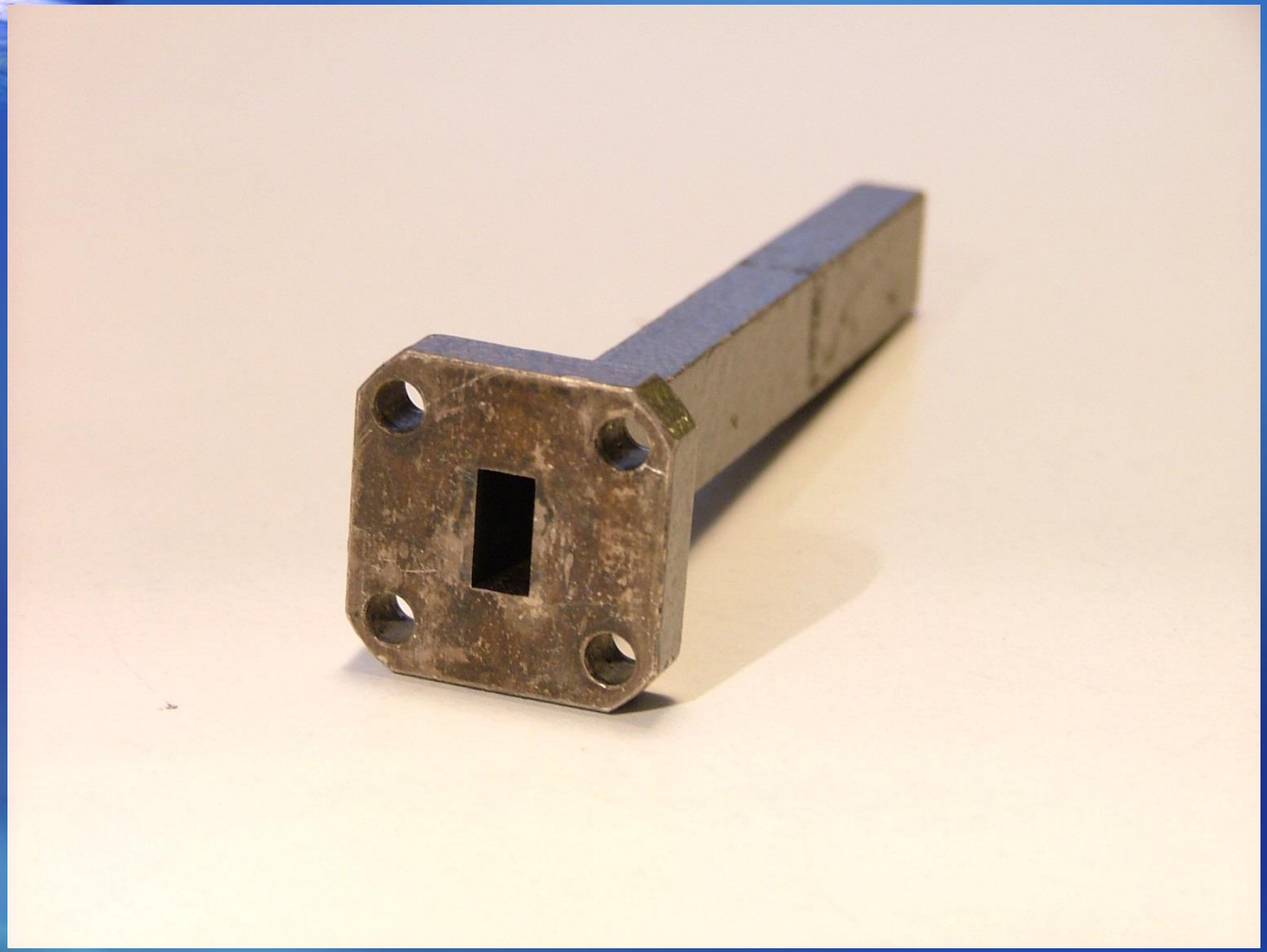
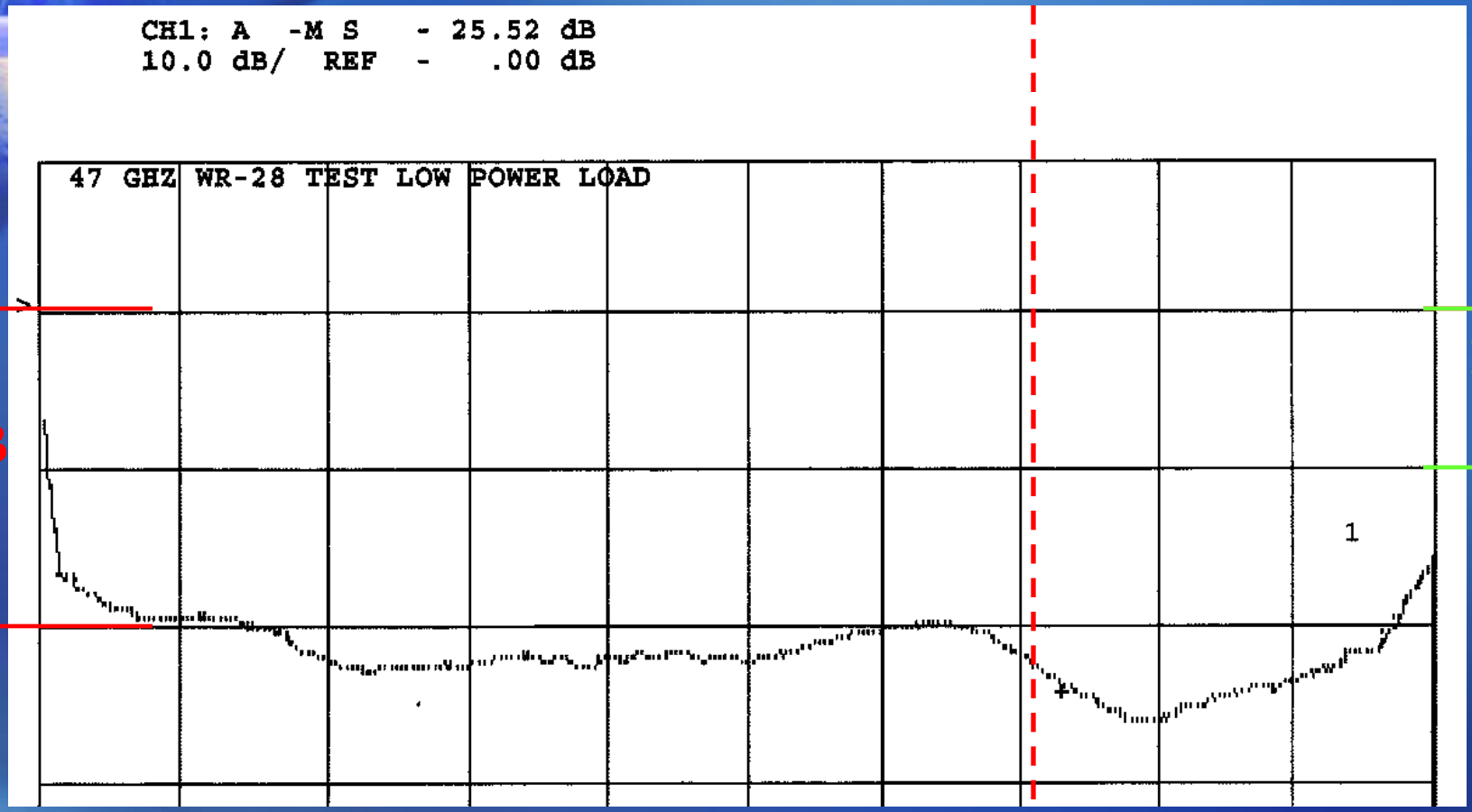
50 GHz

Test Results- Low Power Load



Test Results- Low Power Load



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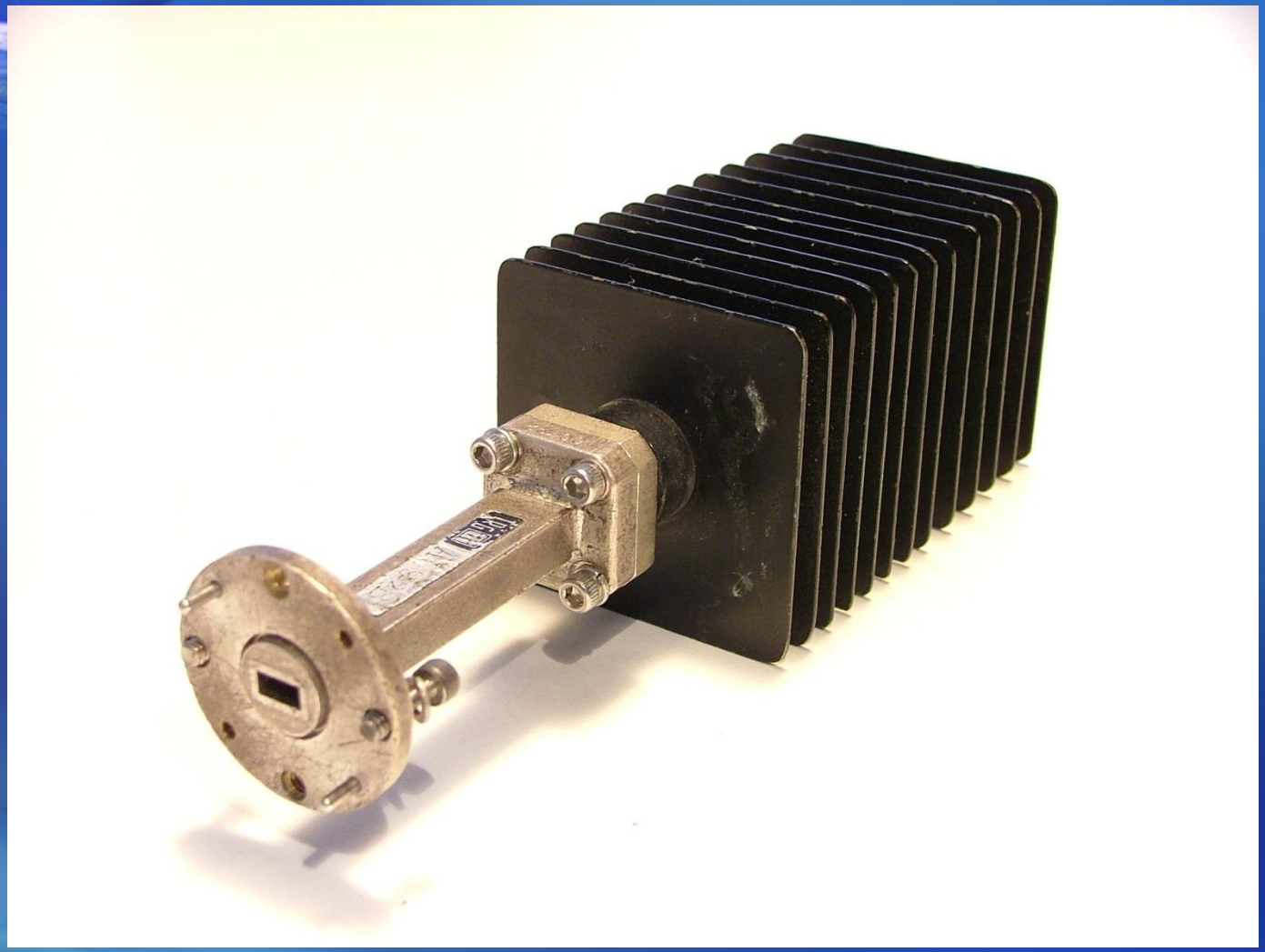
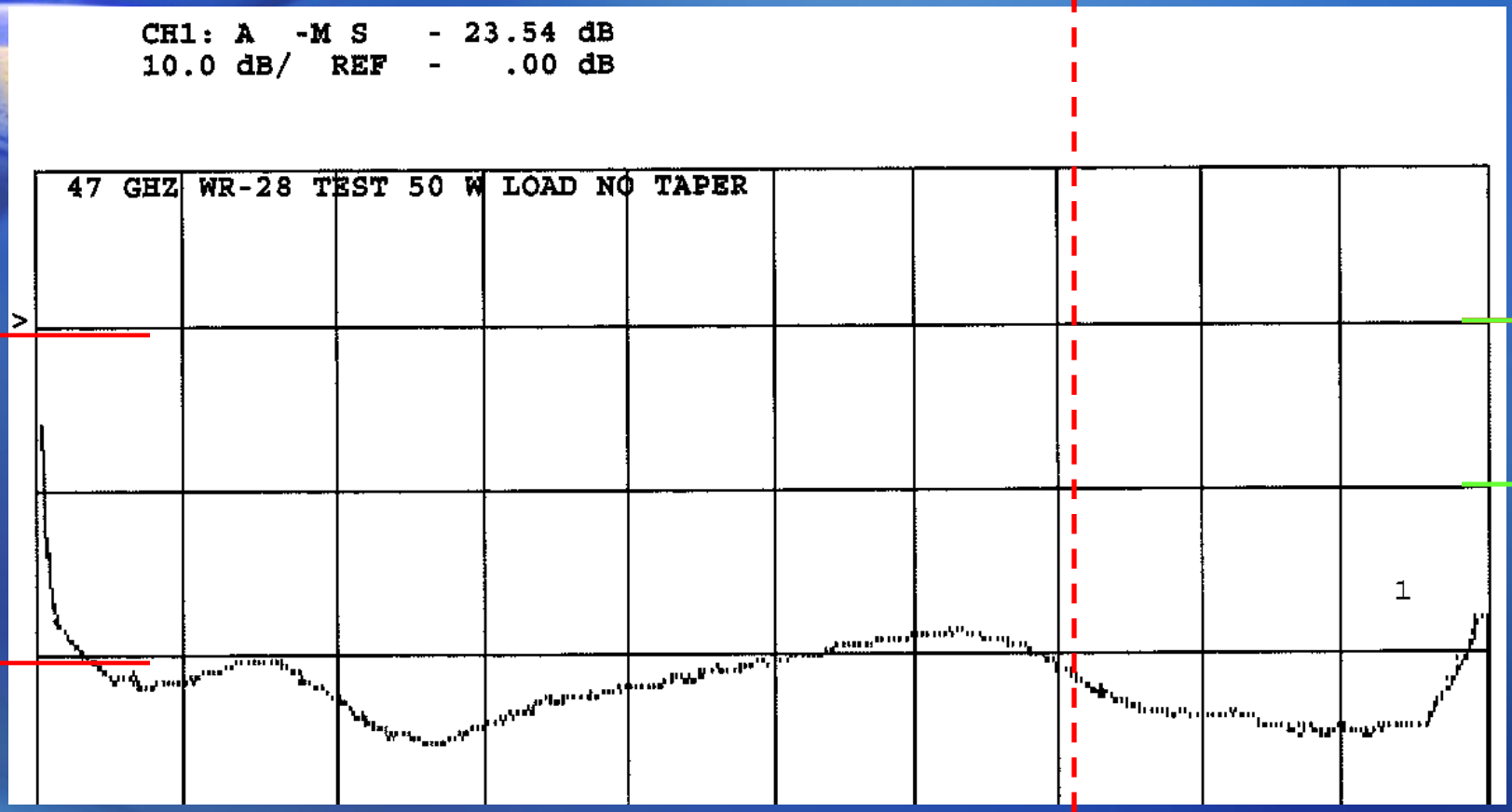
Test Results- High Power Load



Test Results- High Power Load



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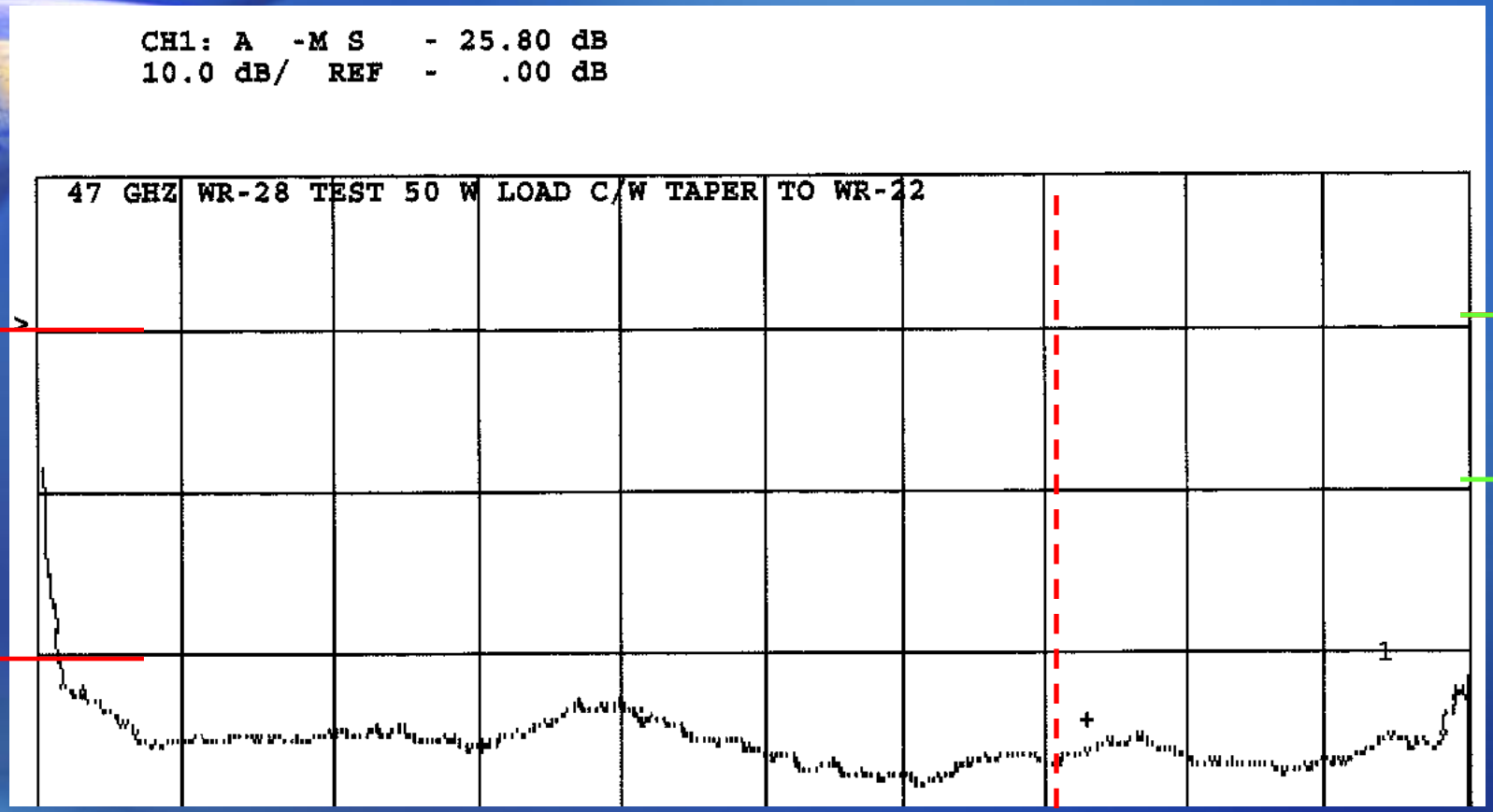
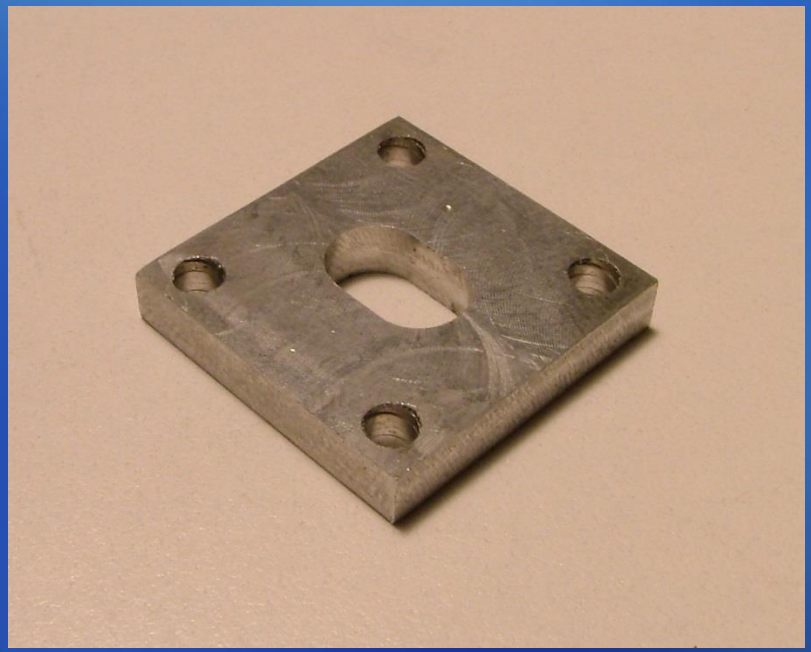
High Power Load With Taper to WR22

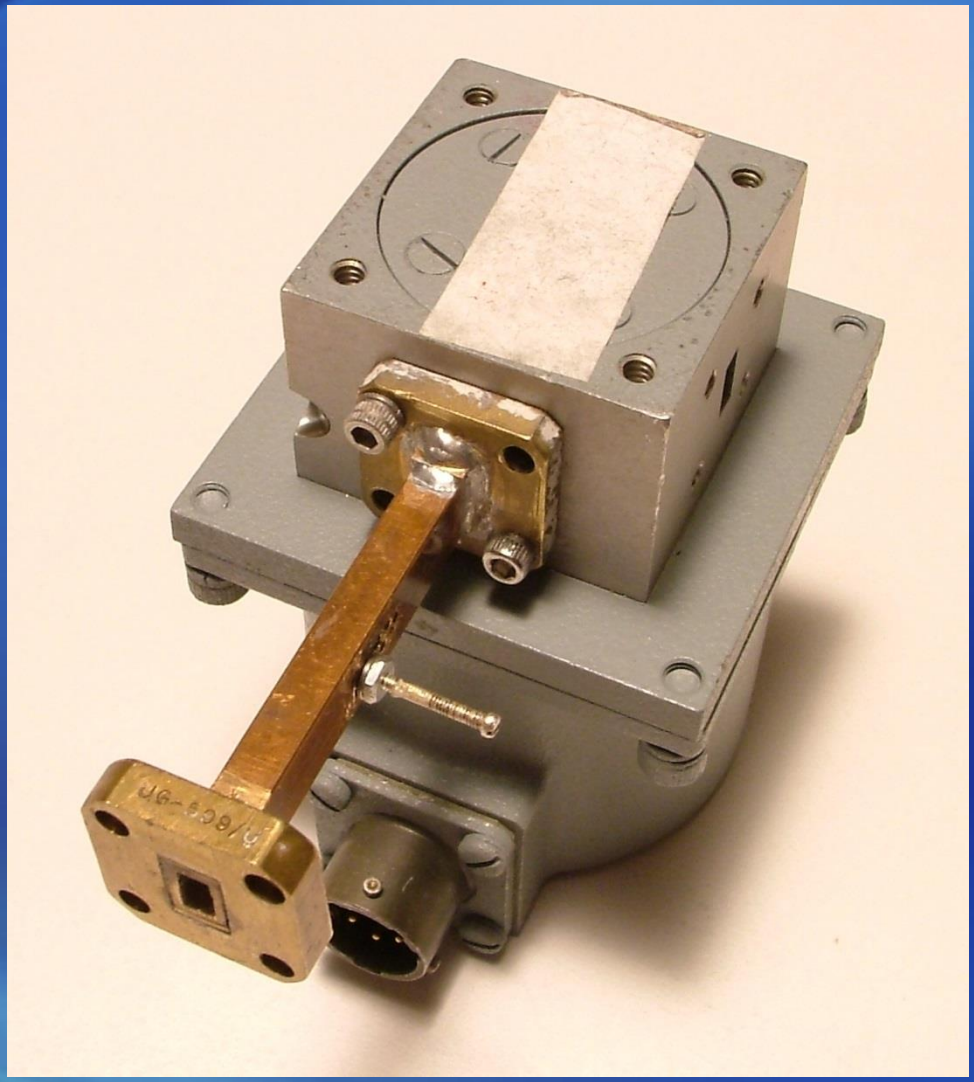


Impedance Matching to WR19/22

- Can Use Bolted Step Transition
- Smooth Taper Gives Better Broadband Results
- ¼ Wavelength Transformer OK for Narrower Bandwidth



Waveline 1077 “E Plane” WG Switch



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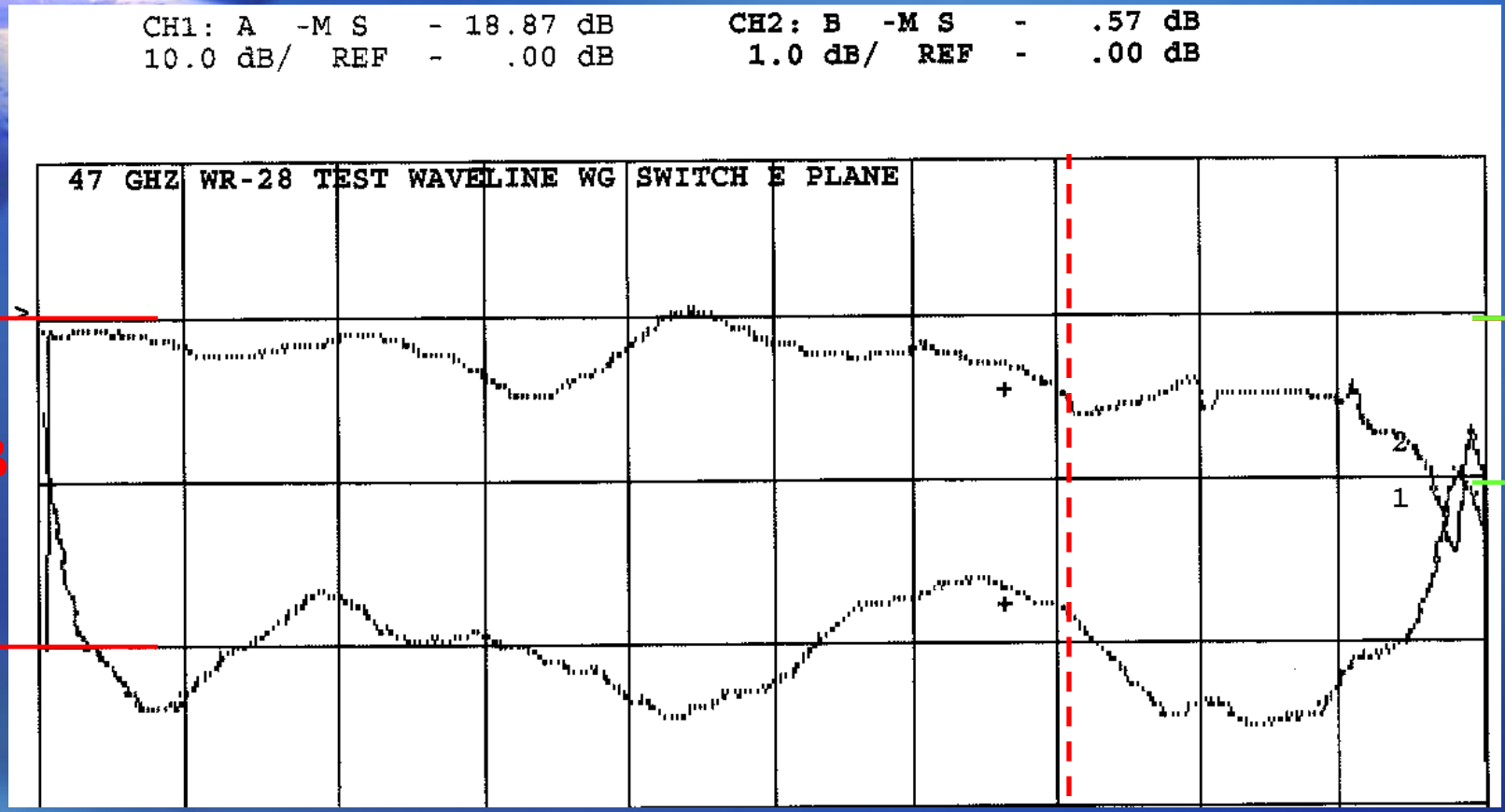

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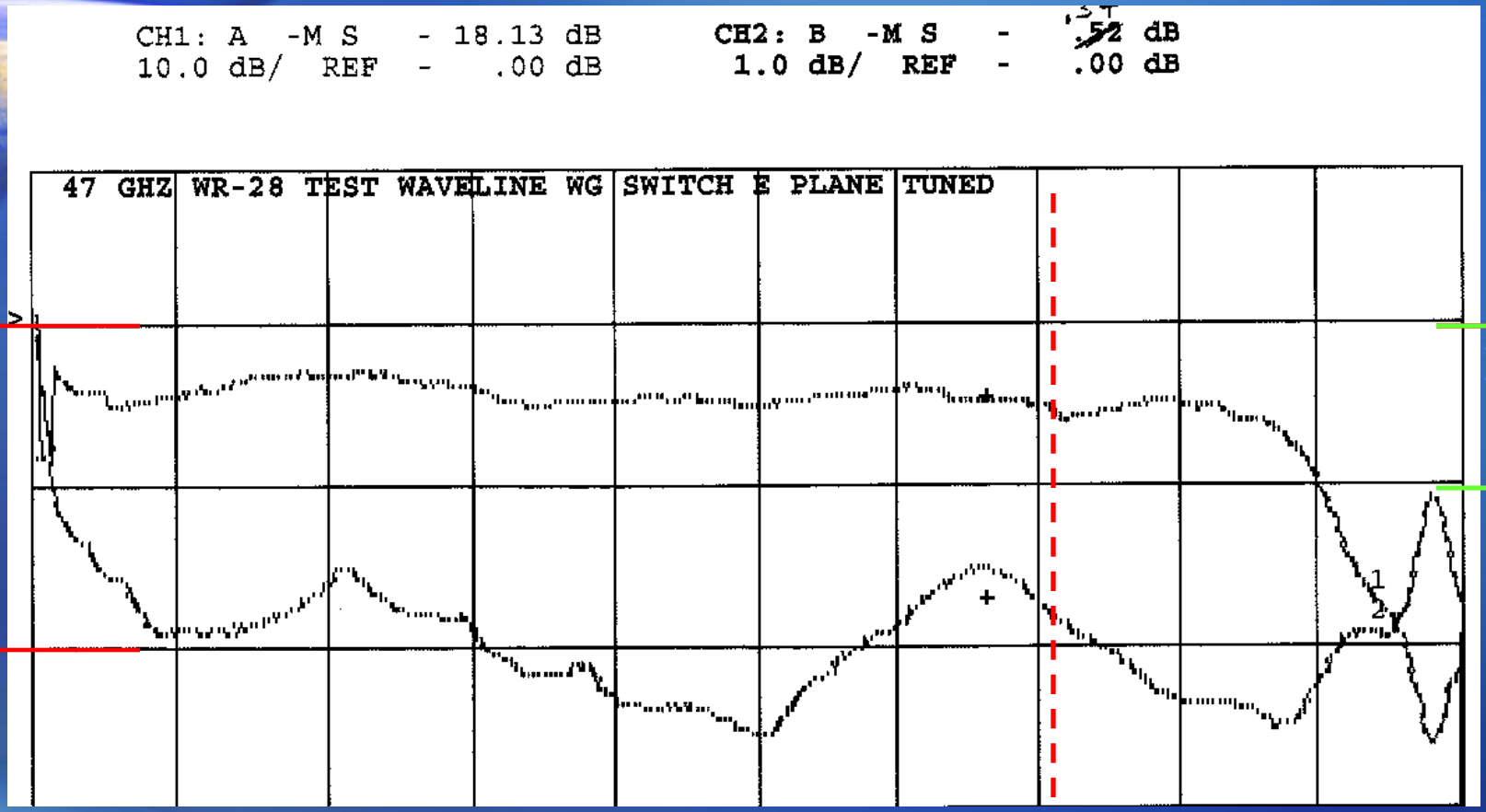
1077 “E Plane” WG Switch “Tuned”



20 dB RL

1 dB IL

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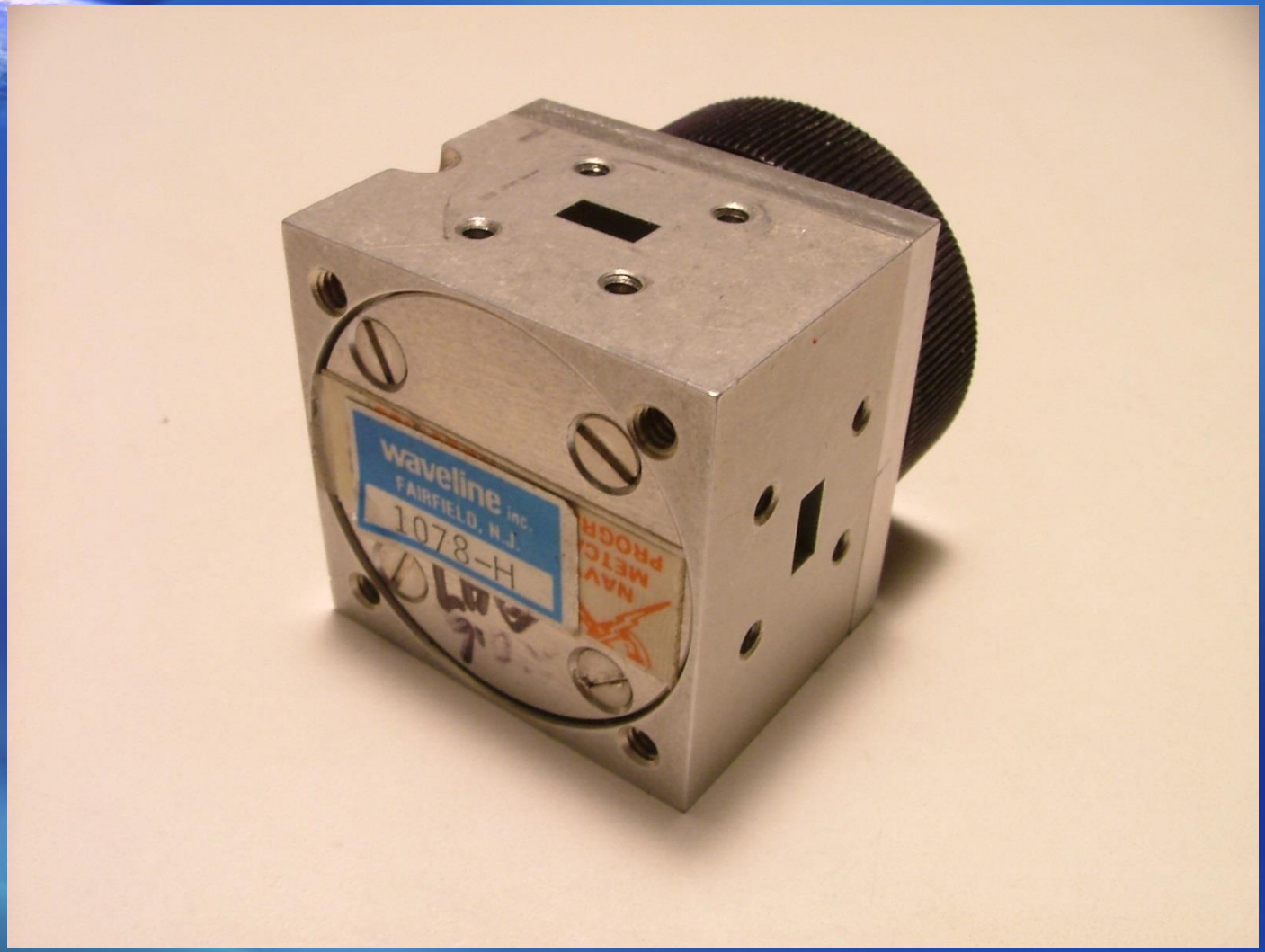
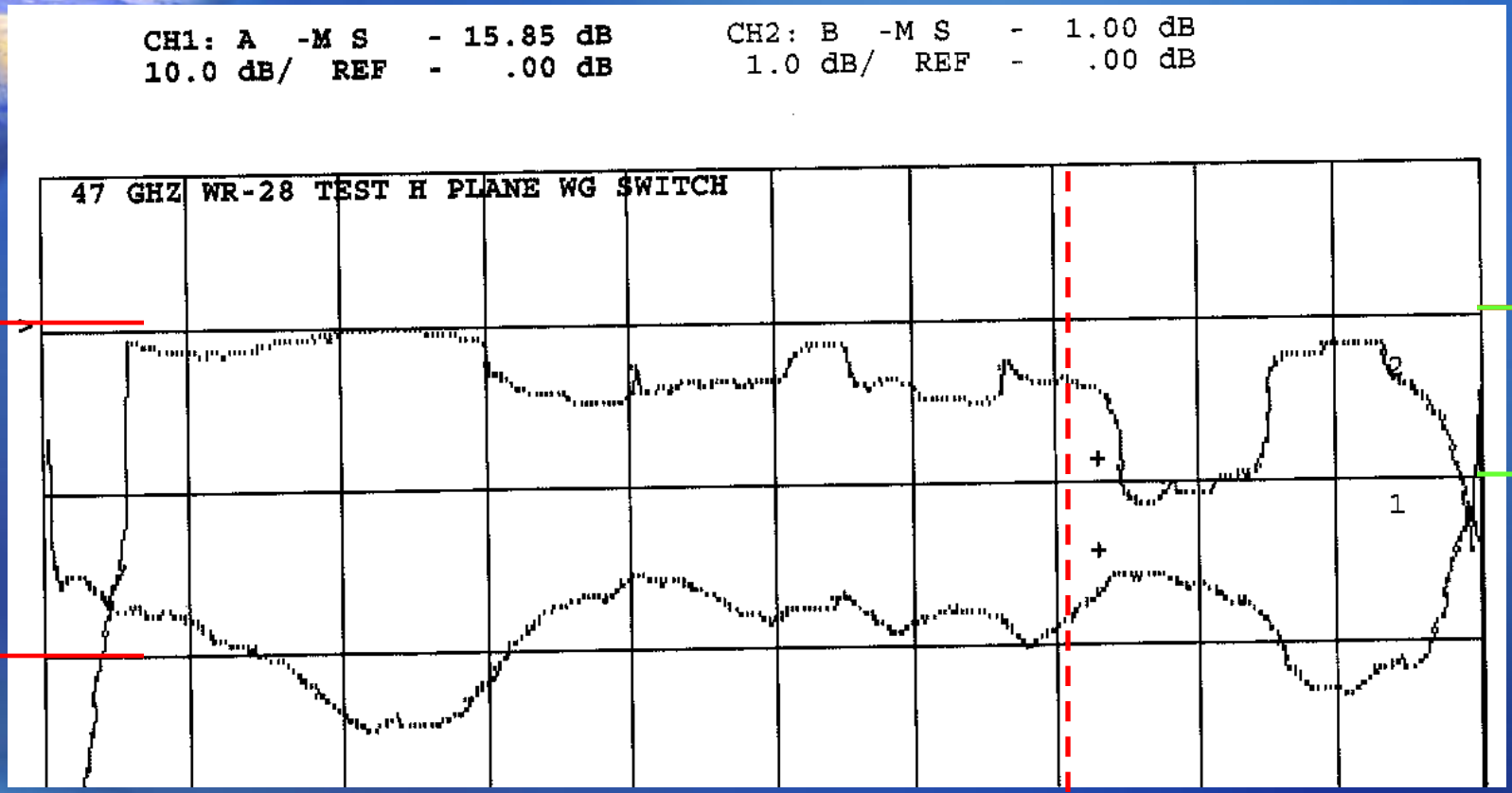
Waveline 1078 “H Plane” WG Switch



Waveline 1078 “H Plane” WG Switch



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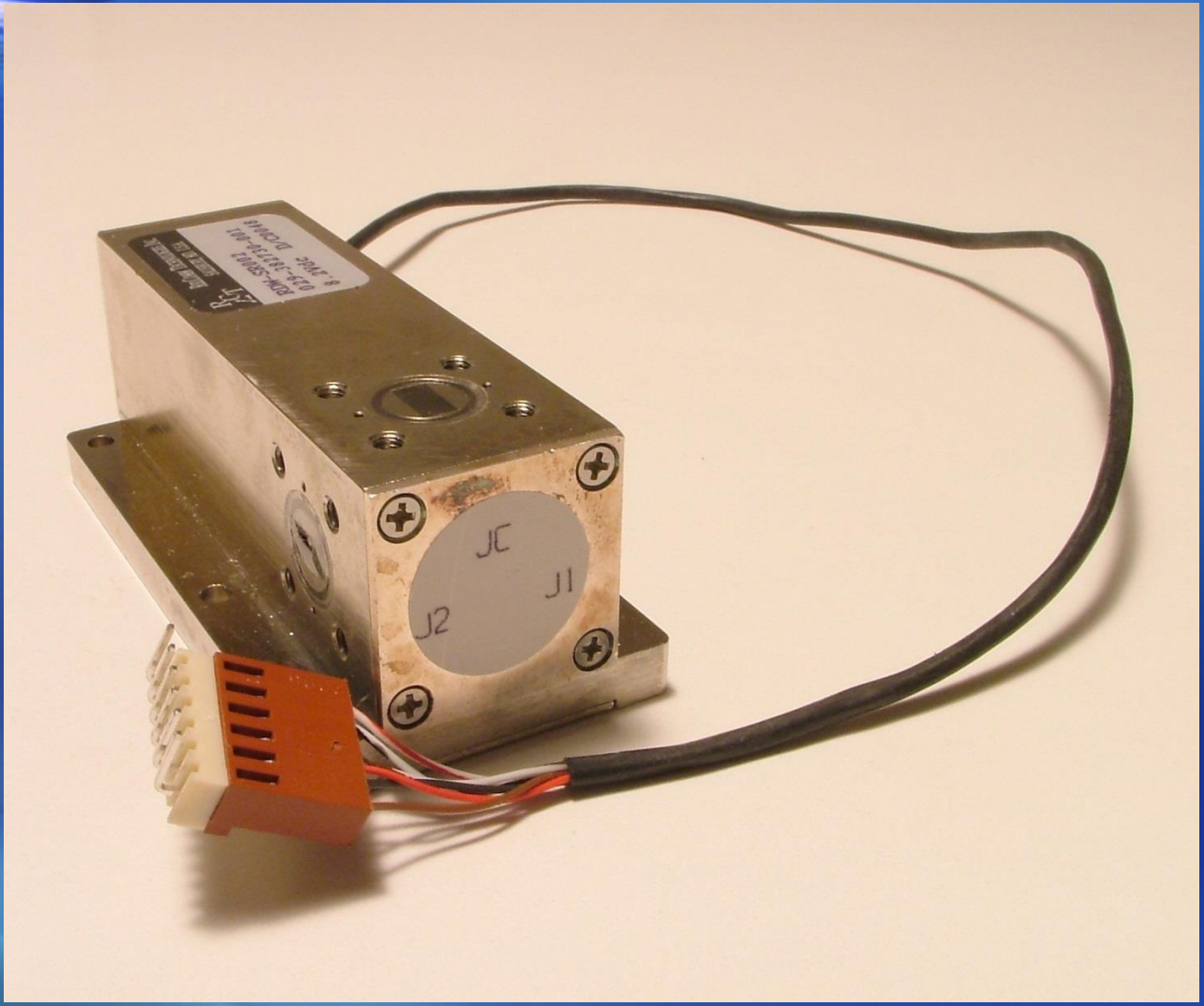
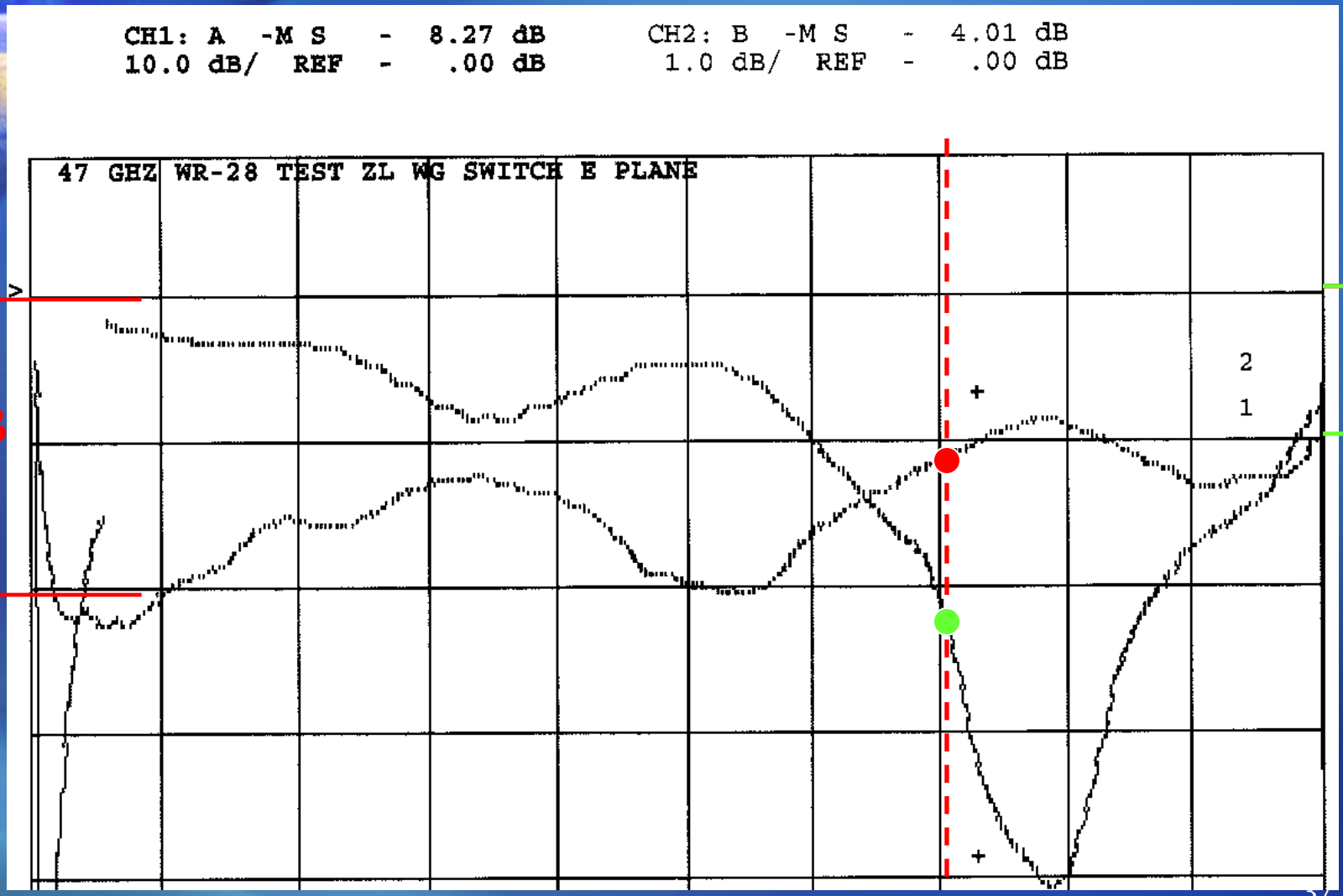
RelComm Tech “ZL” E Plane Switch



RelComm Tech "ZL" E Plane Switch



MCS R382-B Broadwall Coupler

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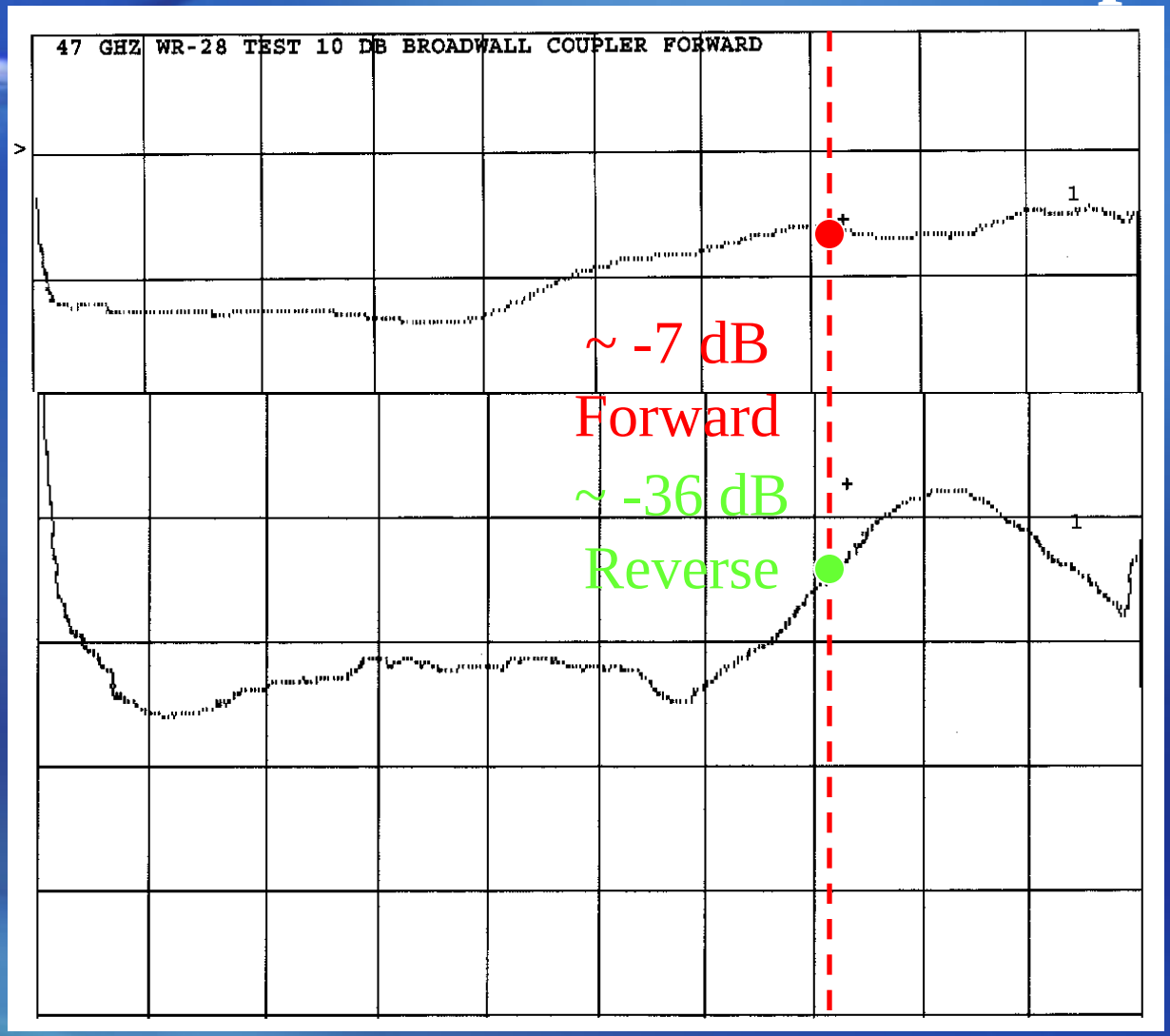

40 GHz 47 GHz 50 GHz

47 GHz WR28 WG Recommendations

- OK to Use WR28 If Lowest Loss Not Req'd
- Use Only Short Straight Sections If Possible
- "E" Bend Best, and 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
- Choke Flanges are Suspect…Test Them!

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