Karlsruhe Institute of Technology

Antennenmesstechnik

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INSTITUT FÜR HOCHFREQUENZTECHNIK UND ELEKTRONIK

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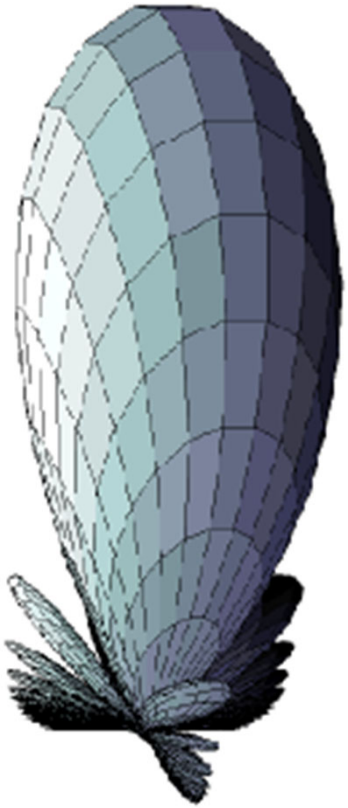
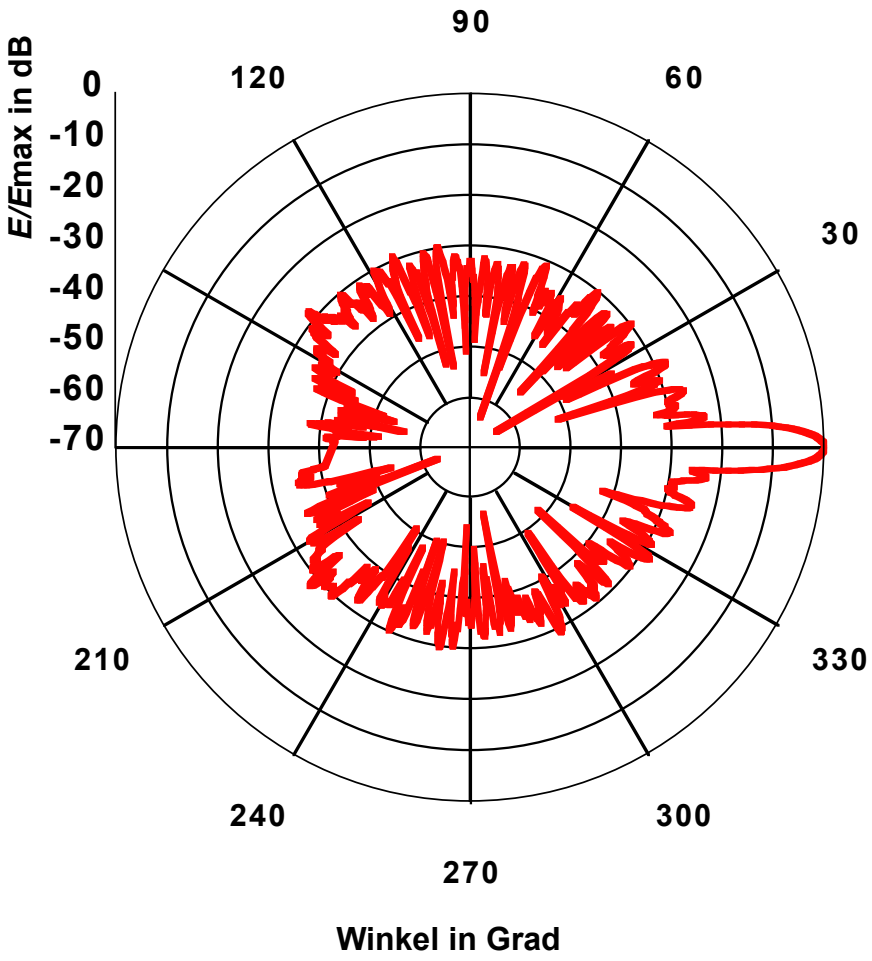
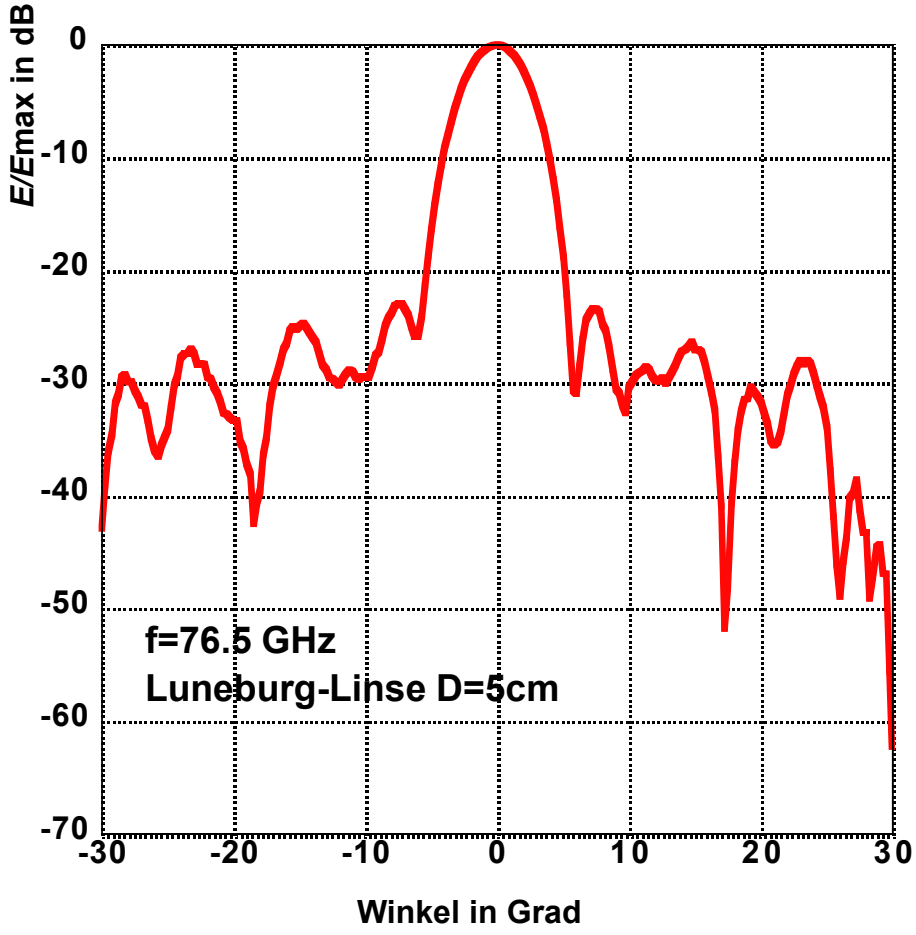
3-D Richtdiagramm einer Antenne

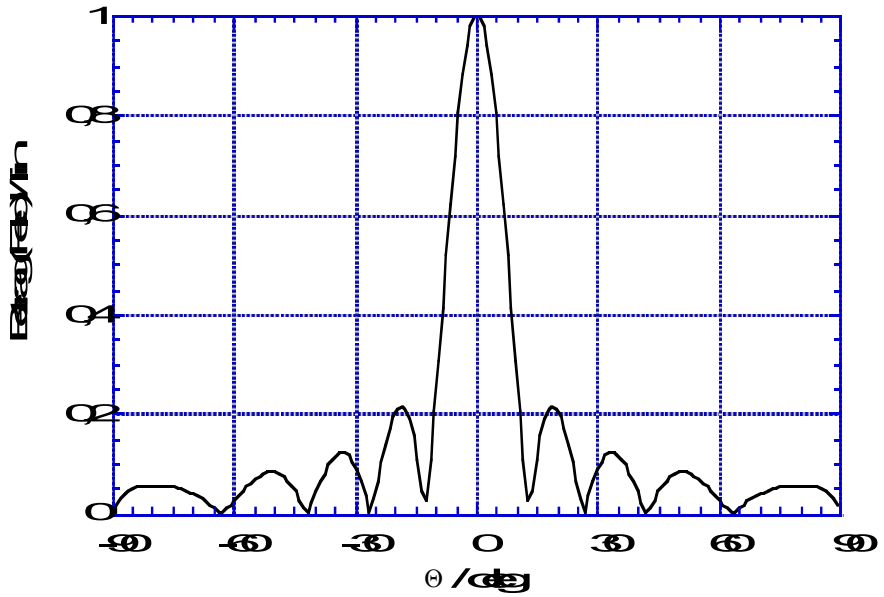


Richtdiagramme polar und kartesisch



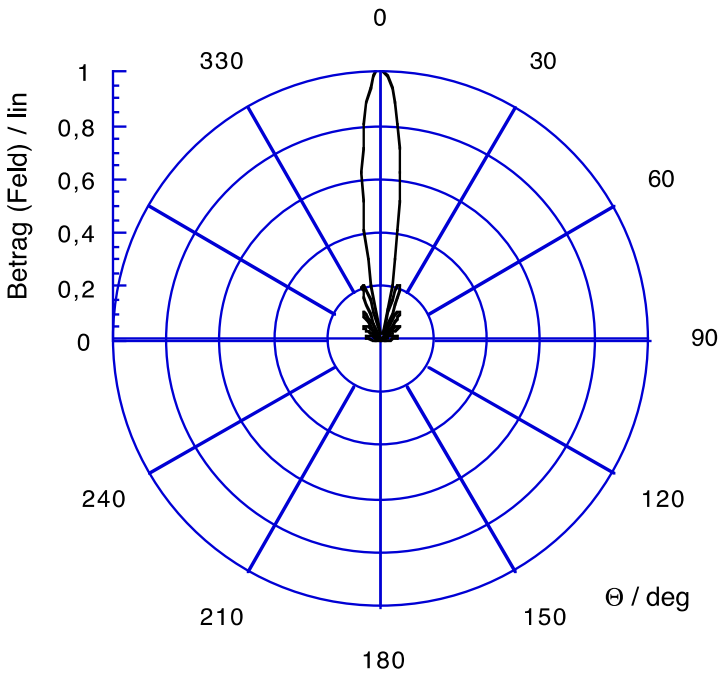


Richtcharakteristiken, linearer Maßstab

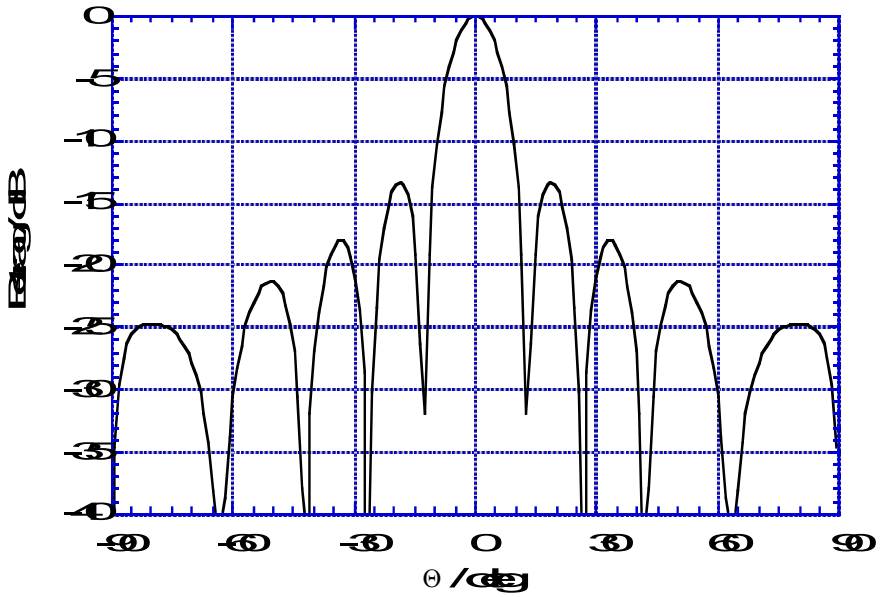


Rectangular plot, magnitude linear

Polar plot, magnitude linear

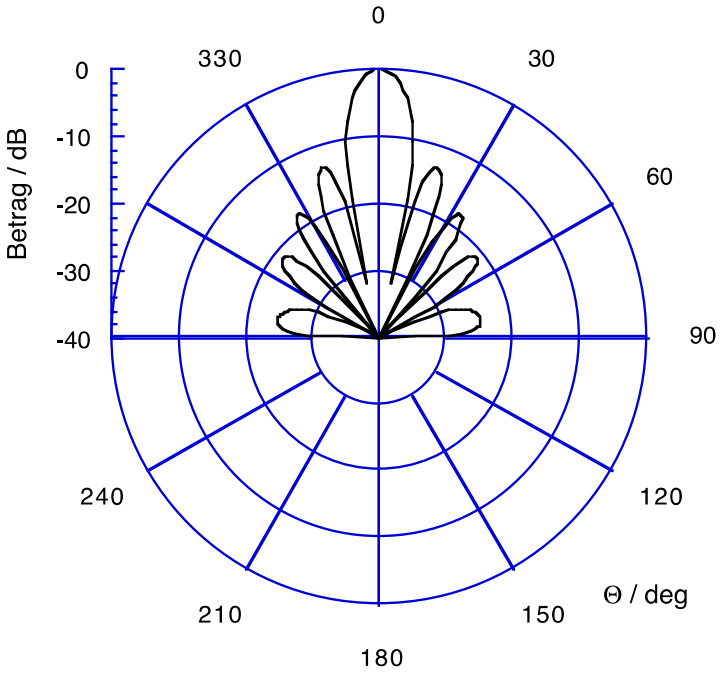


Richtcharakteristik, logarithmischer Maßstab



Rectangular plot, magnitude in dB

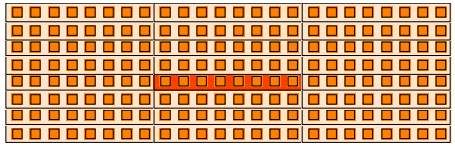
Polar plot, magnitude in dB



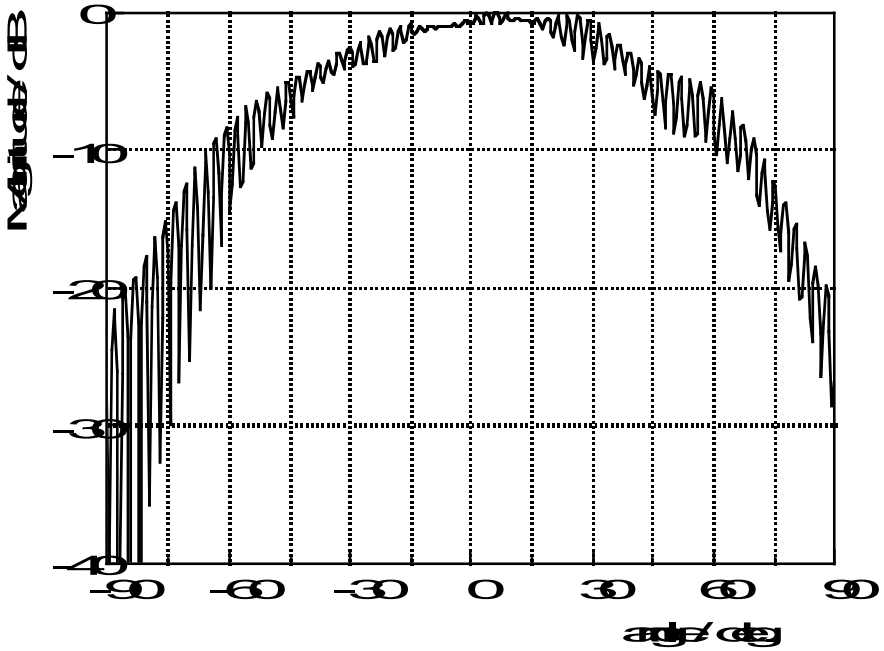
Messung elliptisch und zirkular polarisierter Antennen

Sendepolarisation linear, rotierend!

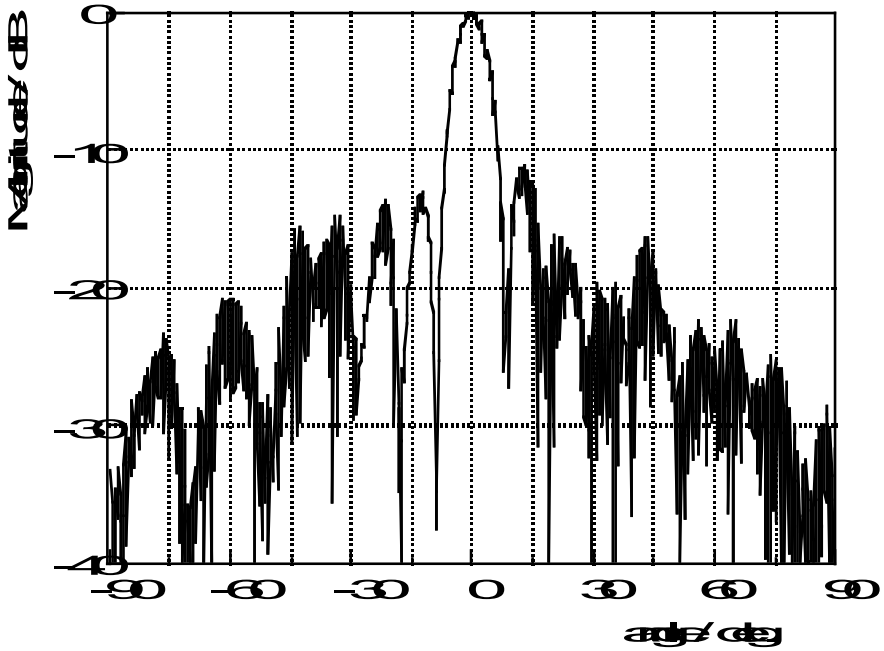
Zirkular polarisierte Antenne 1x8 Array



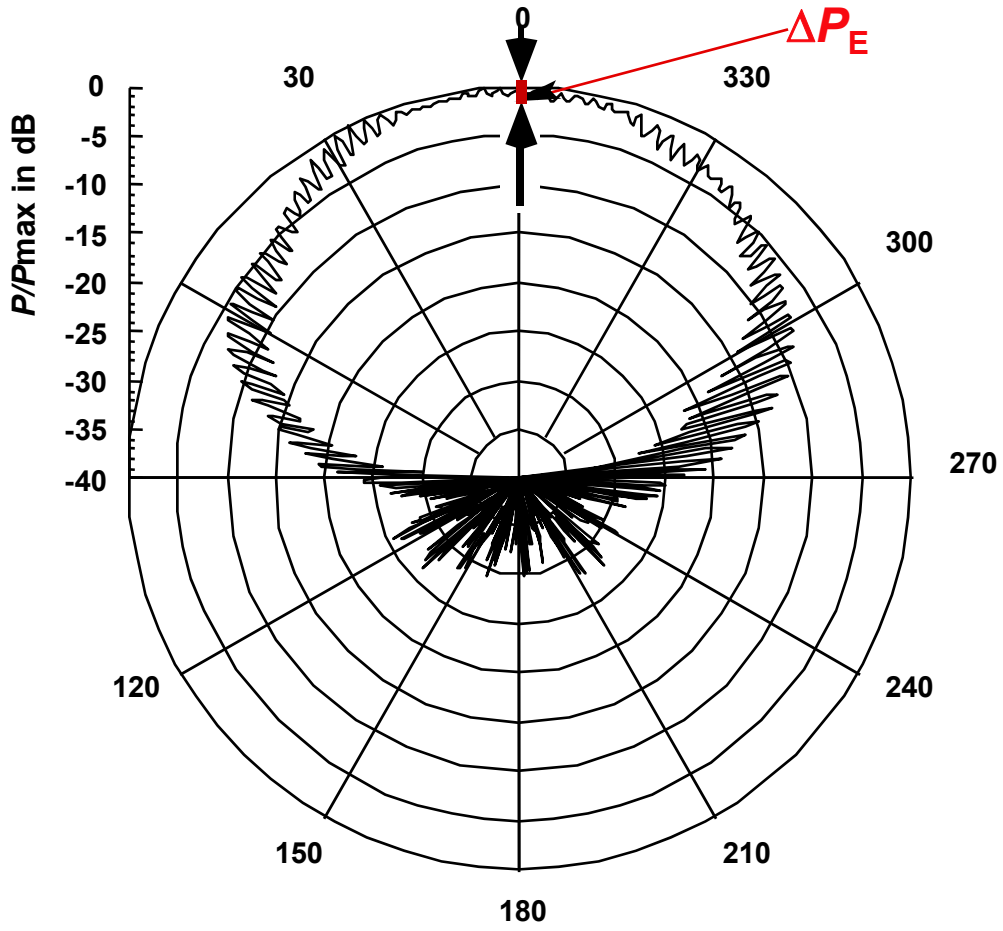
Elevation



Azimuth



Zirkular polarisierte Antenne mit Elliptizität ΔP_E



Axial ratio:

$$AR = \Delta P_E \Big|_{dB} = 10 \cdot \log \Delta P_E$$

Gewinn Reduzierung:

$$G_{red} = \frac{\left(1 + \Delta P_E\right)^2}{2 \cdot \left(1 + \Delta P_E^2\right)}$$

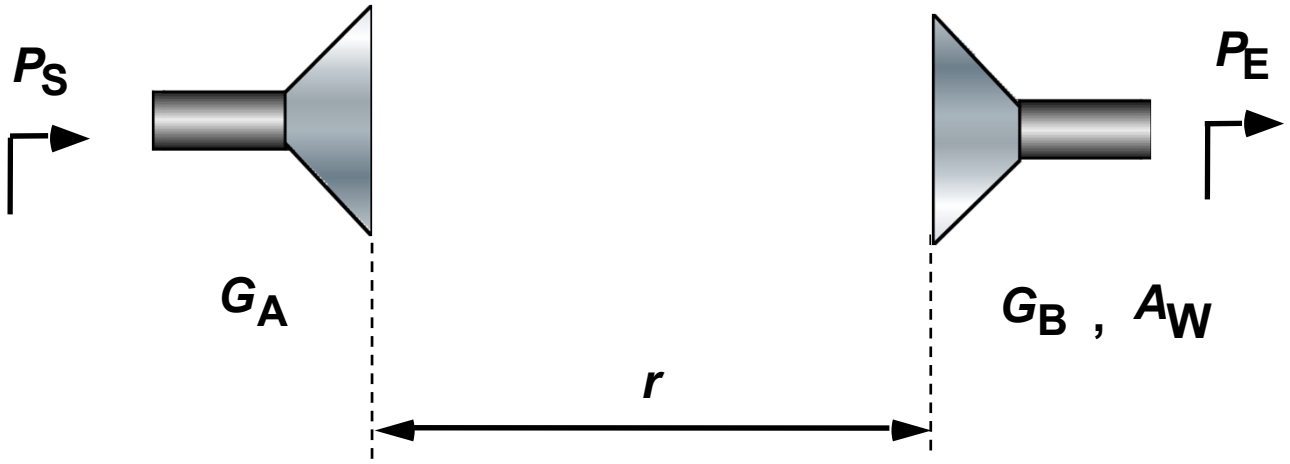
Gewinnmessung

P_E	$=$	S_E	$\bullet$	A_W
Empfangsleistung	$=$	Leistungsdichte	$\bullet$	Antennenwirkfläche
	$=$	$\frac{P_S \cdot G_S}{4\pi r^2}$	$\bullet$	$G_E \frac{\lambda^2}{4\pi}$

$$\frac{P_E}{P_S} = \left(\frac{\lambda}{4\pi r}\right)^2 \cdot G_S \cdot G_E$$

$$10\log\frac{P_E}{P_S} = 20\log\frac{\lambda}{4\pi r} + G_E\big|_{dB} + G_S\big|_{dB}$$

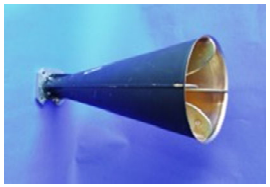
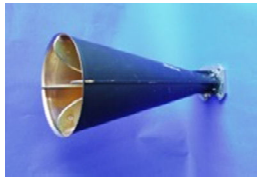
Zwei-Antennen-Methode zur Gewinnmessung



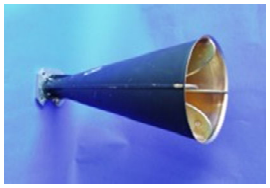
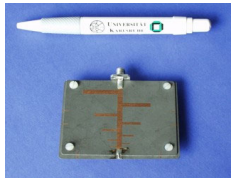
Zwei gleiche Antennen:

$$G_A|_{dB} = G_B|_{dB} = \frac{1}{2}\left[10\log_{10}\left(\frac{P_E}{P_S}\right) - 20\log_{10}\left(\frac{\lambda}{4\pi r}\right)\right]$$

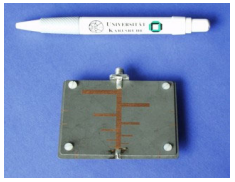
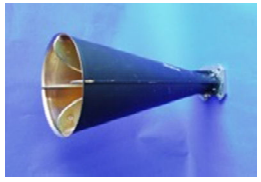
Drei-Antennen-Methode zur Gewinnmessung

A    B

$$10\log\frac{P_E}{P_S} = 20\log\frac{\lambda}{4\pi r} + G_A\big|_{dB} + G_B\big|_{dB}$$

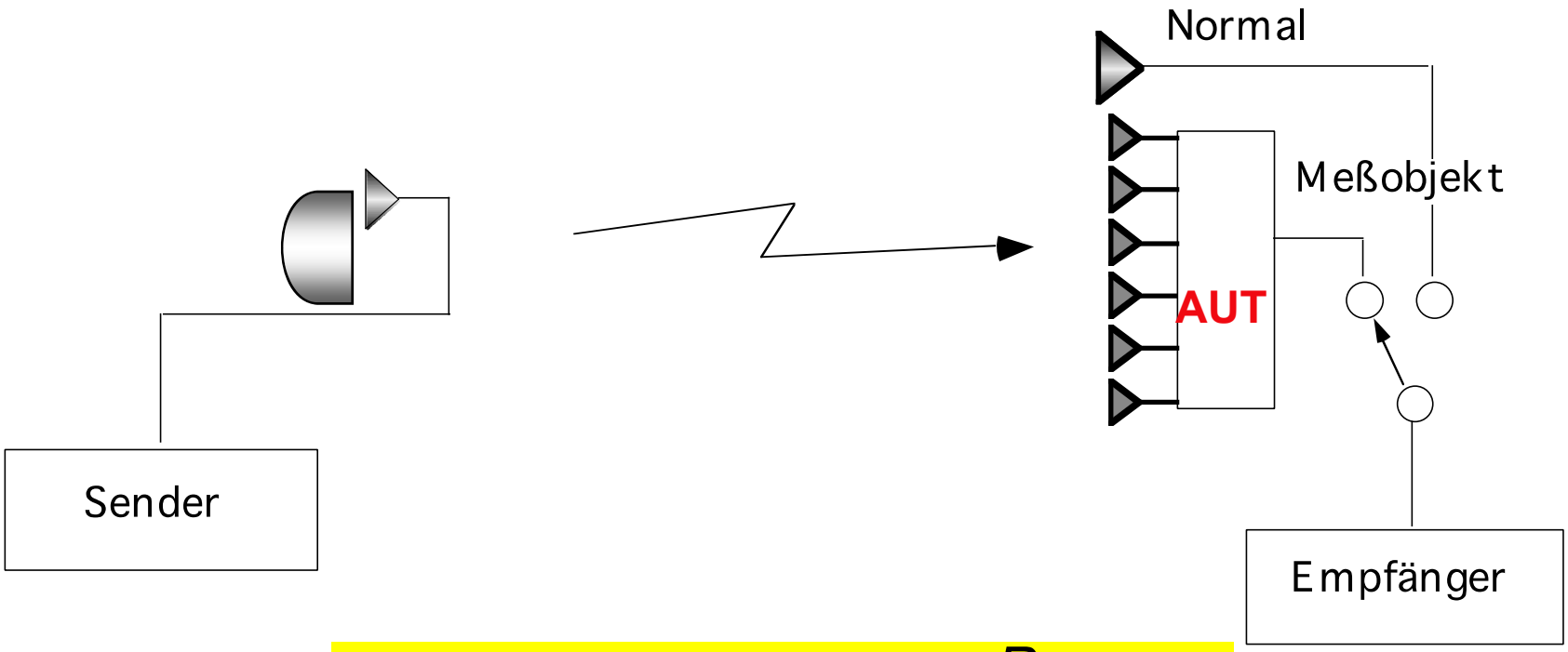
A    C

$$10\log\frac{P_E}{P_S} = 20\log\frac{\lambda}{4\pi r} + G_A\big|_{dB} + G_C\big|_{dB}$$

C    B

$$10\log\frac{P_E}{P_S} = 20\log\frac{\lambda}{4\pi r} + G_C\big|_{dB} + G_B\big|_{dB}$$

Gewinnvergleichsverfahren zur Gewinnmessung

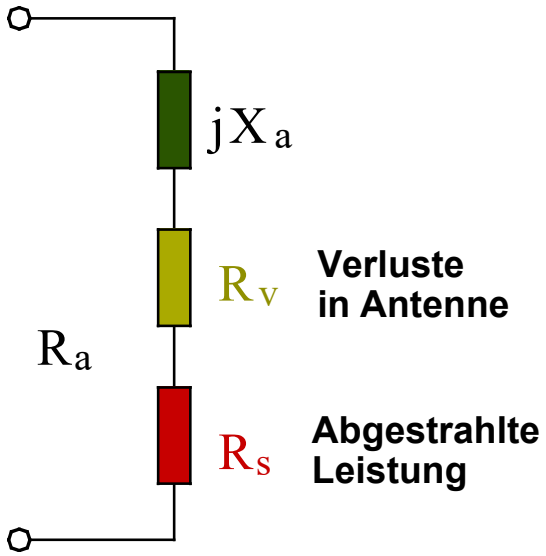


$$G_{AUT}\big|_{dB} = G_{Normal}\big|_{dB} + 10\log\frac{P_{E\ Messobjekt}}{P_{E\ Normal}}$$

Bestimmung des Wirkungsgrades von Antennen

- Wheeler Cap -

Ersatzschaltbild einer Antenne

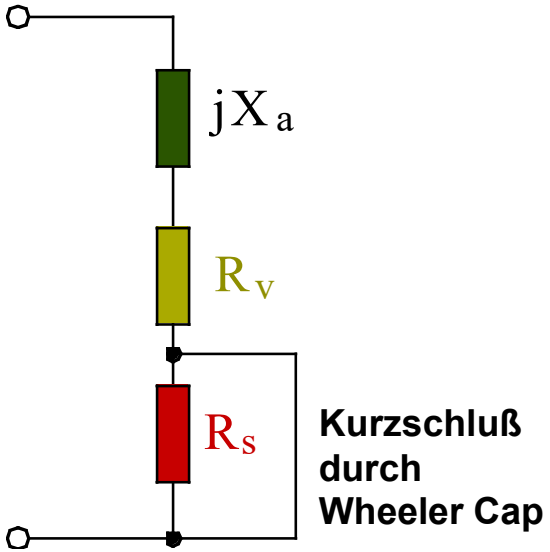


Wirkungsgrad

$$\eta = \frac{R_s}{R_v + R_s}$$

Messung der Antennenimpedanz

$$Z = R_a + jX_a$$



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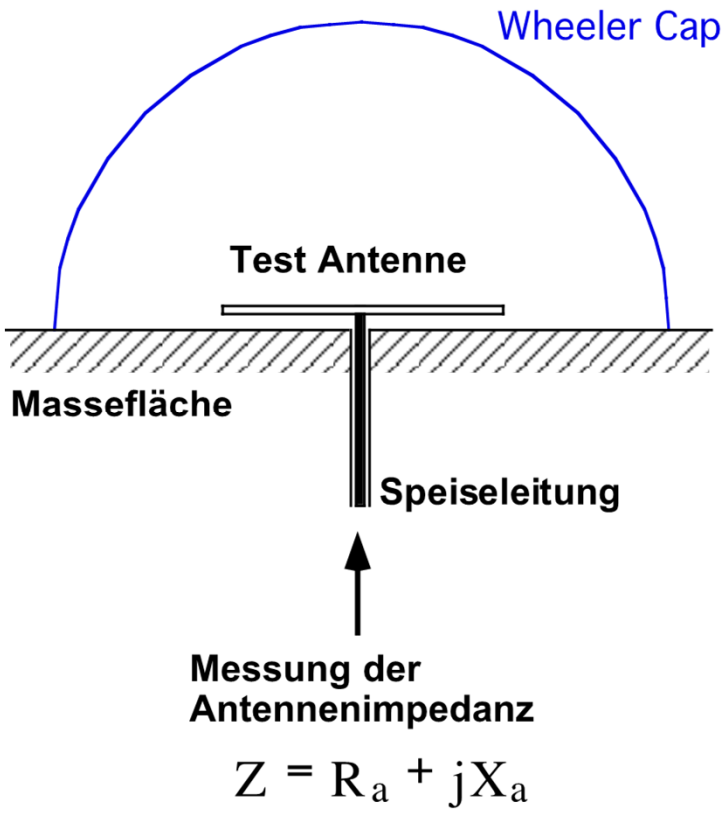
Wheeler Cap zur Messung des Antennenwirkungsgrades



1. Messung des Realteils der Antennenimpedanz ohne Wheeler Cap

$$R_1 = R_V + R_S$$

2. Messung des Realteils der Antennenimpedanz mit Wheeler Cap

$$R_2 = R_V$$

3. Berechnung des Wirkungsgrads

$$\eta = \frac{R_S}{R_V + R_S} = \frac{R_1 - R_2}{R_1}$$