Allgemeines — General

Tera – Atto — Prefixes

T	Tera	10^{12}	c	Zenti/Centi	10^{-2}
G	Giga	10^{9}	m	Milli	10^{-3}
M	Mega	10^{6}	µ	Mikro/Micro	10^{-6}
k	Kilo	10^{3}	n	Nano	10^{-9}
h	Hekto/Hecto	10^{2}	p	Piko/Pico	10^{-12}
da	Deka/Deca	10^{1}	f	Femto	10^{-15}
d	Dezi/Deci	10^{-1}	a	Atto	10^{-18}

Länge

1 Meter (m) = 100 Zentimeter (cm) = 1000 Millimeter (mm) = 1 000 000 Mikrometer (µm).
1 m = 10 Dezimeter (dm).
1 Kilometer (km) = 1000 m.
1 Seemeile = 10 Kabellängen = 1852 m.
1 englische Meile = 1760 Yards = 1609 m.
1 Yard = 3 engl. Fuß = 36 engl. Zoll (") = 91,44 cm.
1 engl. Zoll = 25,4 mm (genau 25,399956 mm).

Measures of length

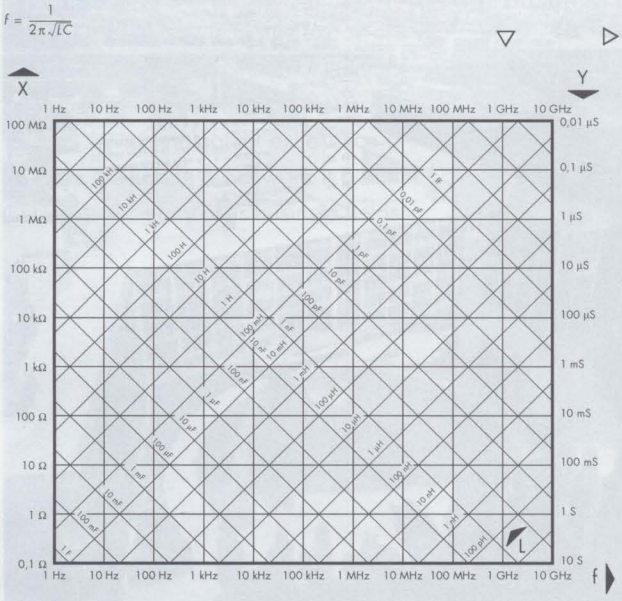
1 meter (m) = 100 centimeters (cm) = 1000 millimeters (mm) = 1 000 000 micrometers (µm).
1 m = 10 decimeters (dm).
1 kilometer (km) = 1000 m.
1 sea mile = 10 cable lengths = 1852 m.
1 English statute mile = 1760 yards = 1609 m.
1 yard = 3 English feet = 36 English inches (") = 91.44 cm.
1 English inch = 25.4 mm (accurately 25.399956 mm).

Engl. Zoll in mm — Inch in mm

engl. Zoll / inch	$\frac{1}{64}$	$\frac{1}{32}$	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$
mm	0,397	0,794	1,587	3,175	4,762	6,350
engl. Zoll / inch	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1"
mm	9,525	12,700	15,875	19,050	22,225	25,400

HF-Tapete — Reactance chart

$$f = \frac{1}{2\pi\sqrt{LC}}$$

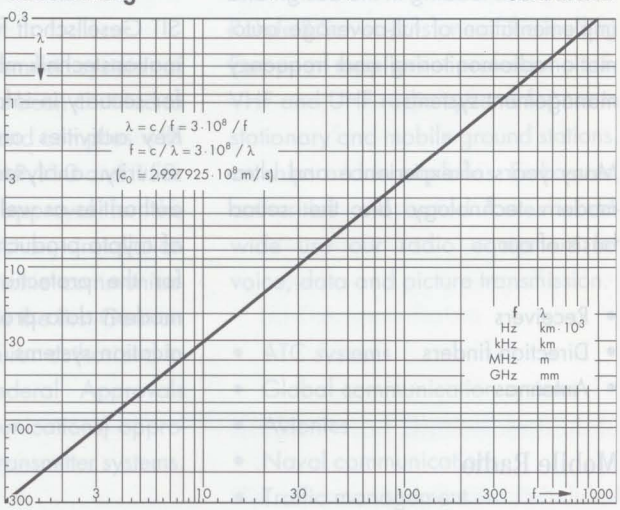


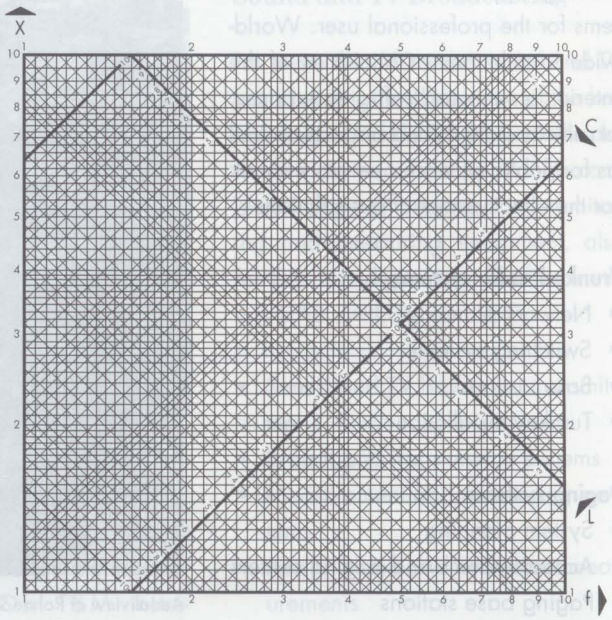
Frequenz — Frequency

Bereich/Range		Bezeichnung/Classification	Band
VLF	3–30 kHz 100–10 km	Längstwellen Very low frequency	4
LF	30–300 kHz 10–1 km	Langwellen Low frequency	5
MF	300–1650 (3000) kHz 1000–182 (100) m	Mittelwellen Medium frequency	6
HF	3–30 MHz 100–10 m	Kurzwellen High frequency	7
VHF	30–300 MHz 10–1 m	Meterwellen Very high frequency	8
UHF	300–3000 MHz 1–0,1 m	Dezimeterwellen Ultra high frequency	9
SHF	3–30 GHz 10–1 cm	Zentimeterwellen Super high frequency	10
EHF	30–300 GHz 10–1 mm	Millimeterwellen Extremely high frequency	11

Umrechnung — Conversion

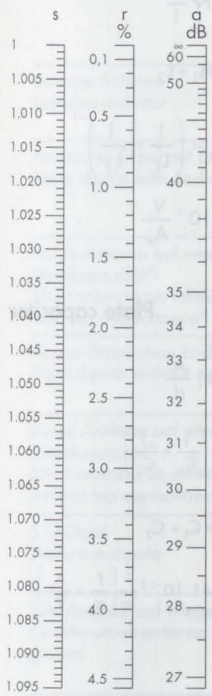
$f/\lambda \leftrightarrow \lambda/f$





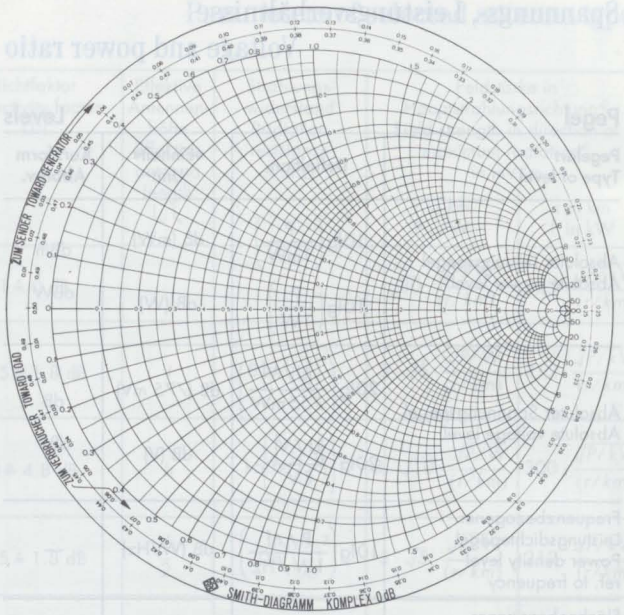
Reflexion, Anpassung — Reflection, matching

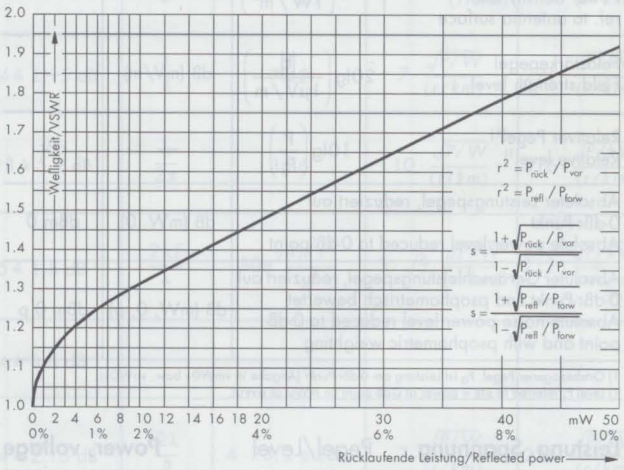
s Welligkeit VSWR
r Reflexion Reflection
a Rückfluß- Return loss
dämpfung

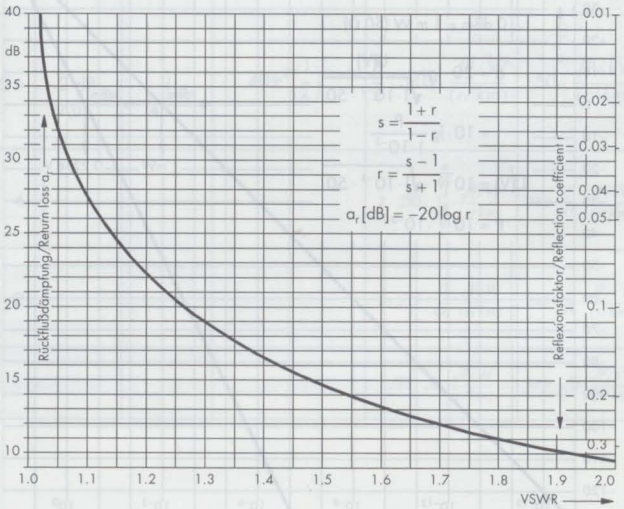


s(VSWR) $\frac{U_{max}}{U_{min}}$	r % $\frac{U\leftarrow}{U\rightarrow}$	P_{refl} %	a dB $20\lg\frac{U\rightarrow}{U\leftarrow}$
1.01	0.50		46.1
1.02	0.99	0.01	40.1
1.03	1.48	0.02	36.6
1.04	1.96	0.04	34.2
1.05	2.44	0.06	32.3
1.06	2.91	0.08	30.7
1.07	3.38	0.11	29.4
10.8	3.85	.015	28.3
1.09	4.31	0.19	27.3
1.10	4.76	0.23	26.4
1.11	5.21	0.27	25.6
1.12	5.66	0.32	24.9
1.13	6.10	0.37	24.3
1.14	6.54	0.43	23.7
1.15	6.98	0.49	23.1
1.16	7.41	0.55	22.6
1.17	7.83	0.61	22.1
1.18	8.26	0.68	21.7
1.19	8.68	0.75	21.2
1.20	9.09	0.83	20.8
1.30	13.0	1.70	17.7
1.40	16.7	2.78	15.6
1.50	20.0	4.00	14.0
1.60	23.1	5.33	12.7
1.70	25.9	6.72	11.7
1.80	28.6	8.16	10.9
1.90	31.0	9.63	10.2
2.00	33.3	11.10	9.5
2.20	37.5	14.1	8.5
2.40	41.2	17.0	7.7
2.60	44.4	19.8	7.0
2.80	47.4	22.4	6.5
3.00	50.0	25.0	6.0
3.50	55.6	30.9	5.1
4.00	60.0	36.0	4.4
5.00	66.7	44.4	3.5
6.00	71.4	51.0	2.9
7.00	75.0	56.2	2.5
8.00	77.8	60.5	2.2
10.0	81.8	66.9	1.7
20.0	90.5	81.9	0.9
50.0	96.1	92.3	0.3

$$s=\frac{1+r}{1-r}=\frac{10^{0.05a}+1}{10^{0.05a}-1} \qquad r=\frac{s-1}{s+1} \qquad a=20\lg\frac{s+1}{s-1}$$







1

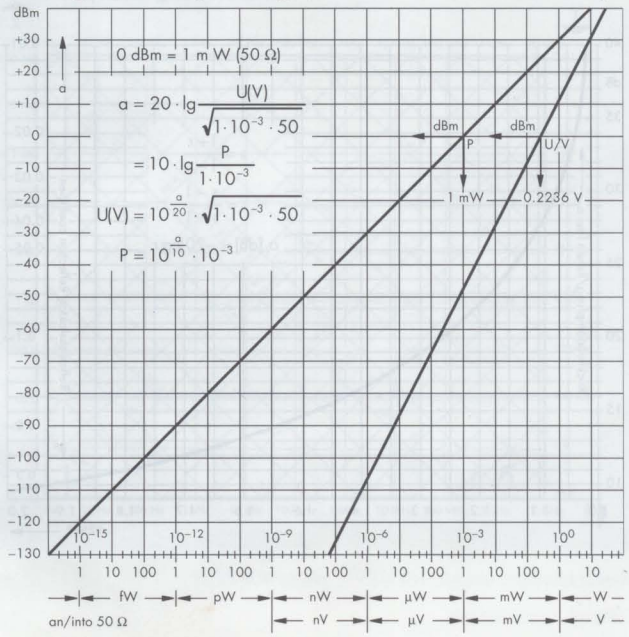
Spannungs-, Leistungsverhältnisse
Voltage and power ratio

Pegel — Levels

Pegelart Type of level	Definition	»Einheit« Unit	Kurzform Abbrev.
Absoluter Leistungspegel Absolute power level	$10\lg\left(\frac{P}{1\,mW}\right)$	dB (mW)	dBm
	$10\lg\left(\frac{P}{1\,W}\right)$	dB (W)	dBW
Absoluter Spannungspegel Absolute voltage level	$20\lg\left(\frac{\lvert U/V\rvert}{755\,mW}\right)$	dB (775 mV)	dB
	$20\lg\left(\frac{\lvert U/V\rvert}{1\,V}\right)$	dB (V)	dBV
Frequenzbezogener Leistungsdichtepegel Power density level ref. to frequency	$10\lg\left(\frac{P/\Delta f}{1\,W/Hz}\right)$	dB (W/Hz)	—
Flächenbezogener Leistungsdichtepegel Power density level ref. to antenna surface	$10\lg\left(\frac{P/A}{1\,W/m^2}\right)$	dB (W/m²)	—
Feldstärkepegel Field strength level	$20\lg\left(\frac{\lvert E\rvert}{1\,\mu V/m}\right)$	dB (mV/m)	—
Relativer Pegel[1] Relative level[1]	$10\lg\left(\frac{P}{P_0}\right)$	—	dBr
Absoluter Leistungspegel, reduziert auf 0-dBr-Punkt Absolute power level reduced to 0-dB point		dB (mW, 0)	dBm 0
Absoluter Geräuschleistungspegel, reduziert auf 0-dBr-Punkt und psophometrisch bewertet Absolute noise power level reduced to 0-dB point and with psophometric weighting		dB (mW, 0, p)	dBm 0 p

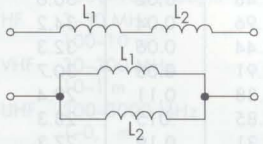
1) Ortsbezogener Pegel, P_0 ist Leistung am 0-dBr-Punkt (Angabe in »mW0« bzw. »pW0«).
1) Level P_s referred to site = power at 0-dB point (in mW0 or pW0).

Leistung, Spannung — Pegel/Level — Power, voltage



Induktivität, Kapazität
Inductance, capacitance

Zylinderspule — Cylindrical coil



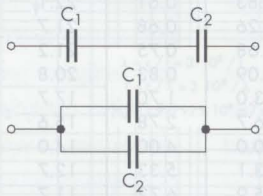
$$L = \mu_0\,\mu_r\,N^2\,\frac{A}{l}$$

$$L_{ges/total} = L_1 + L_2$$

$$L_{ges/total} = \left(\frac{1}{L_1} + \frac{1}{L_2}\right)^{-1}$$

$$\mu_0 = 4\pi \cdot 10^{-7}\,\frac{V_s}{A_m}$$

Plattenkondensator — Plate capacitor



$$C = \varepsilon_0\,\varepsilon_r\,\frac{A}{d}$$

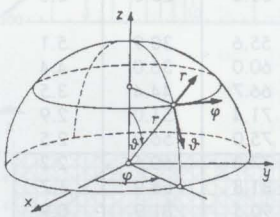
$$C_{ges/total} = \left(\frac{1}{C_1} + \frac{1}{C_2}\right)^{-1}$$

$$C_{ges/total} = C_1 + C_2$$

$$\varepsilon_0 = 8.8541 \cdot 10^{-12}\,\frac{F}{m}\left[\frac{F}{m} = \frac{A_s}{V_m}\right]$$

Wellenwiderstand des Freiraumes
Characteristic impedance of free space

$$Z_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}} = 120\,\pi\Omega \approx 377\,\Omega$$



φ = Azimut/Azimuth
90° − ϑ = Elevation

Maximale Empfangsleistung — Maximum receive power

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

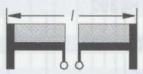
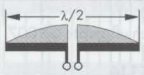
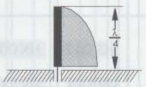
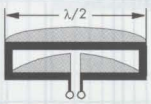
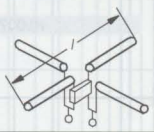
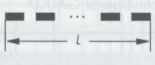
$$P_{rec} = P_{trans} \cdot G_{trans} \cdot G_{rec} \cdot \left(\frac{\vartheta}{4\pi r}\right)$$

$$g_{ec} = 10 \cdot \log G_{rec}$$

$$g_{rec} = 10 \cdot \log G_{rec}$$

Kenngrößen ausgewählter Antennenformen

Parameters of selected antenna types

Antennenart Type of antenna	Stromverteilung Current distribution	Richtfaktor Directivity factor D[1]	Effektive Antennenhöhe Effective antenna length l_w l_e	Strahlungswiderstand Radiation resistance R in Ω	Feldstärke in Hauptstrahlungsrichtung[4] Field strength in direction of maximum radiation[4] in mV/m	
					r in km P in W	r in km P in kW
Isotrope Antenne Isotropic radiator		1 ≙ 0 dB			$\sqrt{30}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$173\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Hertzscher Dipol mit Endkapazität[3] Hertz dipole with end capacitance[3]		1.5 ≙ 1.8 dB	l	$80\pi^2\left(\frac{l}{\lambda}\right)^2$	$3\cdot\sqrt{5}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$212\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Kurze Antenne auf ∞leitendem Boden mit Dachkapazität[2] Short antenna on infinitely conducting ground with top capacitance[2]		3 ≙ 4.8 dB	h	$160\pi^2\left(\frac{h}{\lambda}\right)^2$	$3\cdot\sqrt{10}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$300\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Kurzer Dipol ohne Endkapazität[3] Short dipole without end capacitance[3]		1.5 ≙ 1.8 dB	$\frac{l}{2}$	$20\pi^2\left(\frac{l}{\lambda}\right)^2$	$3\cdot\sqrt{5}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$212\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Kurze Antenne auf ∞leitendem Boden ohne Dachkapazität[2] Short antenna on infinitely conducting ground without top capacitance[2]		3.0 ≙ 4.8 dB	$\frac{h}{2}$	$40\pi^2\left(\frac{h}{\lambda}\right)^2$	$3\cdot\sqrt{10}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$300\cdot\frac{\sqrt{P/kW}}{(r/km)}$
λ/2-Dipol Halfwave dipole		1.64 ≙ 2.15 dB	$\frac{\lambda}{\pi}$	73.2	$7\cdot\frac{\sqrt{P/W}}{(r/km)}$	$221\cdot\frac{\sqrt{P/kW}}{(r/km)}$
λ/4-Antenne auf ∞leitendem Boden Quarter-wave antenna on infinitely conducting ground		3.28 ≙ 5.2 dB	$\frac{\lambda}{2\pi}$	36.6	$10\cdot\frac{\sqrt{P/W}}{(r/km)}$	$316\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Kleiner Einwindungsrahmen im freien Raum Small single-turn loop in free space	Rahmenfläche F beliebige Form Loop surface S any shape	1.5 ≙ 1.8 dB	$\frac{2\pi F}{\lambda}$	$80\pi^2\frac{4\pi^2F^2}{\lambda^4}$	$3\cdot\sqrt{5}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$212\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Ganzwellendipol, λ-Dipol Full-wave dipole		2.4 ≙ 3.8 dB				
Gefalteter λ/2-Dipol Folded halfwave dipole		1.64 ≙ 2.15 dB	$\frac{2\lambda}{\pi}$	$4\cdot 73,2 \cong 280$	$7\cdot\frac{\sqrt{P/W}}{(r/km)}$	$221\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Drehkreuzantenne (Hertzsche Dipole) Strahlung in Horizontalebene Turnstile antenna (Hertz dipole) radiating in horizontal plane		0.75 ≙ −1.2 dB	l	$40\pi^2\left(\frac{l}{\lambda}\right)^2$	$\frac{3}{2}\cdot\sqrt{10}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$150\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Dipolzeile (Einzelelemente sind Hertzsche Dipole) Broadside array (Hertz dipoles) (L >> λ)		$4\cdot\frac{L}{\lambda}$			$2\cdot\sqrt{30}\cdot\sqrt{\frac{l}{\lambda}}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$346\cdot\sqrt{\frac{l}{\lambda}}\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Dipollinie (Einzelelemente sind Hertzsche Dipole) Collinear array (Hertz dipoles) (L >> λ)		$2\cdot\frac{L}{\lambda}$			$2\cdot\sqrt{15}\cdot\sqrt{\frac{l}{\lambda}}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$245\cdot\sqrt{\frac{l}{\lambda}}\cdot\frac{\sqrt{P/kW}}{(r/km)}$
Antenne mit dem Richtfaktor D Antenna with directivity D		D			$\sqrt{30}\cdot\sqrt{D}\cdot\frac{\sqrt{P/W}}{(r/km)}$	$173\cdot\sqrt{D}\cdot\frac{\sqrt{P/kW}}{(r/km)}$

[1] Entspricht dem Gewinn bei verlustloser Antenne
Corresponds to gain with loss-free antenna

[2] $h < 0.1\,\lambda$

[3] $l < 0.2\,\lambda$

[4] Antenne und Umgebung verlustlos
Antenna and surroundings loss-free

HF Whip Antenna HA104/512

10 kHz to 30 MHz/
1.5 to 30 MHz (Rx/Tx)
For ground waves and vertically polarized low-angle sky waves

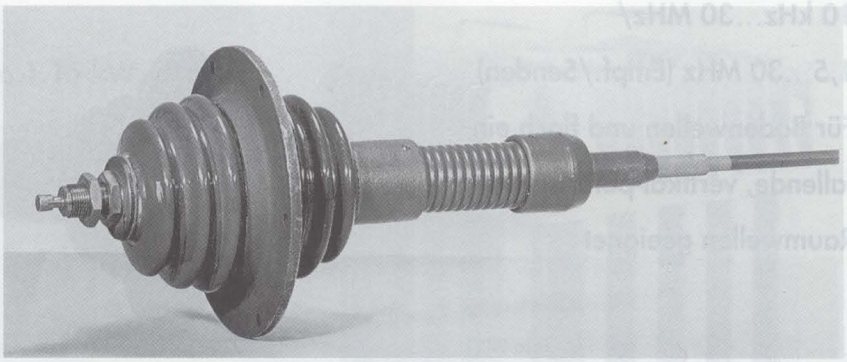


Photo 3721

Brief description

The HF Whip Antenna HA104/512 is suitable for ground waves and vertically polarized low-angle sky waves. In conjunction with an antenna tuning unit, it can also be used for transmission.

Special features

- Sturdy construction
- Shock- and vibration-proof
- For mobile use

Specifications

Frequency range	
Reception	10 kHz to 30 MHz
Transmission (with ATU)	1.5 to 30 MHz
Polarization	vertical
Max. input power	150 W CW and PEP
Horizontal pattern	omnidirectional
Connector	screw terminal
Max. wind speed	150 km/h
Height of antenna	5 m
Dismantling possible	yes
Weigth	4 kg

Ordering information

HF Whip Antenna	HA104/512	0156.2039.02

Recommended extras

Antenna Tuning Unit	FK2100	6046.8948.02
Ground Net	HA229/100	0103.5727.02

Rotatable Log-Periodic Antenna System AK451

5 to 30 MHz

For transmission and reception of horizontally polarized waves over medium to long distances

Brief description

The compact Rotatable Log-Periodic Antenna System AK451 is used for the transmission and reception of horizontally polarized waves. Due to a transmission frequency range from 5 to 30 MHz, the antenna system is particularly suitable for operation over medium to long distances despite its extremely small size. Reception is possible from 2 MHz thus covering all distances.

Special features

- Extremely small dimensions (size of loaded 6.2-MHz antenna)
- Transmission from 5 MHz, reception from 2 MHz
- Unrestricted λ/2 dipole element characteristics leading to high antenna gain
- Easy and quick assembly
- Little maintenance required

Photo 36609-1

Specifications

Frequency range	5 to 30 MHz (reception 2 to 30 MHz)
Polarization	horizontal
Nominal impedance	50 Ω
VSWR	≤2
Max. input power	1 kW
Gain	6 to 12.5 dBi
Radius of rotation	8.3 m
Range of rotation	±(n × 360°)
Max. wind speed	180 km/h
MTBF	>100,000 h
Dimensions	
Length of antenna	15 m
Width of antenna	16 m
Weight	260 kg

Ordering information

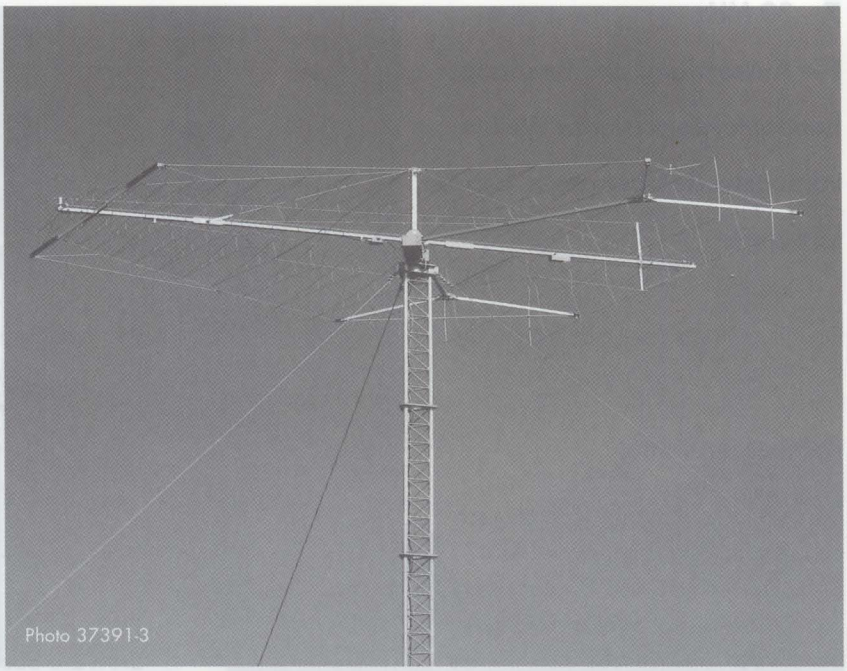
Log-Periodic HF Antenna	HL451	0733.8507.02
15-m Lattice Mast	KM451B2	4028.3400.02
Antenna Rotator	RD008	0720.6300.02
Mounting Kit/Rotary Joint	RD008Z1	0720.6400.02
Control Unit (manual)	RB040	4003.2100.02
Control Unit (remote/computer controlled)	BG030	0749.8501.02

Other configurations on request

Rotatable Log-Periodic Antenna System AK471

7 to 30 MHz

For transmission an reception of horizontally polarized waves especially over long distances



Brief description

The compact Rotatable Log-periodic Antenna System AK471 is used for the transmission and reception of horizontally polarized waves. Due to its transmission frequency range from 7 to 30 MHz it is used especially over long distances. Reception is possible from 3 to 30 MHz leading to coverage of almost all distances. Its low weight and small size make the antenna system ideal for installation on roofs.

Special features

- Smallest dimensions
- Low weight
- Easy and quick assembly
- Little maintenance required

Specifications

Frequency range	7 to 30 MHz (reception 3 to 30 MHz)
Polarization	horizontal
Nominal impedance	50 Ω
VSWR	≤2
Max. input power	1 kW
Gain	6 to 12.5 dBi (typ.)
at 7 MHz	0 dBi
at 8 MHz	6 dBi
Radius of rotation	5 m
Range of rotation	±(n × 360°)
Max. wind speed	180 km/h
MTBF	>100,000 h
Dimensions	
Length of antenna	8.8 m
Width of antenna	11 m
Weight	100 kg

Ordering information

Log-Periodic HF Antenna	HL471	0755.3008.02
15-m Lattice Mast	KM451B2	4028.3400.02
Antenna Rotator	RD008	0720.6300.02
Mounting Kit/Rotary Joint	RD008Z1	0720.6400.02
Control Unit (manual)	RB040	4003.2100.02
Control Unit (remote/computer controlled)	BG030	0749.8501.02

Other configurations on request

UHF Coaxial Dipole HK001

225 to 400 MHz

Omnidirectional antenna with vertical polarization featuring high suppression of skin currents

Photo 24215

Brief description

The UHF Coaxial Dipole HK001 is an omnidirectional antenna with vertical polarization featuring high suppression of skin currents. Due to its sturdy design it is also suitable for mobile use, in particular on board ships.

Special features

- Low weight
- Minimal wind load
- Sturdy design
- High suppression of skin currents
- Protected against lightning

Specifications

Frequency range	225 to 400 MHz
Polarization	vertical
Nominal impedance	50 Ω
VSWR	≤2
Max. input power	400 W (rms)
Gain	2 dBi typ.
Horizontal pattern	circular
Connector	N female
Max. wind speed	185 km/h
Operating temperature	–40 to +85 °C
Dimensions (dia. × H)	430 mm × 470 mm
Weight	1.6 kg

Ordering information

UHF Coaxial Dipole	HK001	0425.2781.03

VHF Coaxial Dipole HK012

100 to 165 MHz

Omnidirectional antenna with vertical polarization featuring high suppression of skin currents

Photo 31166

Brief description

The VHF Coaxial Dipole HK012 is an omnidirectional antenna with vertical polarization featuring high suppression of skin currents. Due to its sturdy design it is also suitable for mobile use, in particular on board ships.

Special features

- Low weight
- Minimal wind load
- Sturdy design
- High suppression of skin currents
- Protected against lightning

Specifications

Frequency range	100 to 165 MHz
Polarization	vertical
Nominal impedance	50 Ω
VSWR	≤2
Max. input power	400 W (rms)
Gain	2 dBi typ.
Horizontal pattern	circular
Connector	N female
Max. wind speed	160 km/h
Operating temperature	–40 to +85 °C
Dimensions (dia. × H)	250 mm × 1150 mm
Weight	3 kg

Ordering information

VHF Coaxial Dipole	HK012	0459.7611.02

VHF/UHF Coaxial Dipole HK014

100 to 1300 MHz/80 to 1300 MHz

Extremely broadband omnidirectional antenna with vertical polarization featuring high suppression of skin currents

Photo 39646

Brief description

The VHF/UHF Coaxial Dipole HK014 is an omnidirectional antenna with vertical polarization featuring high suppression of skin currents. Due to its sturdy design, it is also suitable for mobile use, in particular on board ships.

Special features

- Wide frequency range
- Low weight
- Minimal wind load
- Sturdy design
- High suppression of skin currents
- Protected against lightning
- Vertical pattern with null fill-in

Specifications

Frequency range	100 to 1300 MHz
Model .12	80 to 1300 MHz
Polarization	vertical
Nominal impedance	50 Ω
VSWR	≤2
Max. input power	
up to 400 MHz	1000 W CW/1600 W PEP
up to 1000 MHz	600 W CW/600 W PEP
up to 1300 MHz	150 W CW
Gain	2 dBi typ.
Horizontal pattern	circular
Connector	N female
Max. wind speed	160 km/h
Operating temperature	–40 to +85 °C
Dimensions (dia. × H)	308 mm × 1100 mm
Model .12	308 mm × 1252 mm
Weight	5 kg

Ordering information

VHF/UHF Coaxial Dipole	HK014	
100 MHz		0644.1514.02
80 MHz		0644.1514.12

Recommended extra

Diplexer for the frequency ranges 100 to 162 MHz and 225 to 400 MHz	FT224	0525.5117.03