**W-type antenna diagrams
(WA, WB, ... WH, WI)**

This type of symmetrical radiation pattern diagram has two main beams. The basic curve is the same as in the case of the V-type, the difference lies in the enveloping radius having one value in the front direction and another in the back direction. The range of the enveloping radius is

       0.35 to 0.80 in the front direction and
       0.00 to 0.45 in the back direction.

      The notation of the type is   mnnWArp
                                 …
                                 mnnW I rp
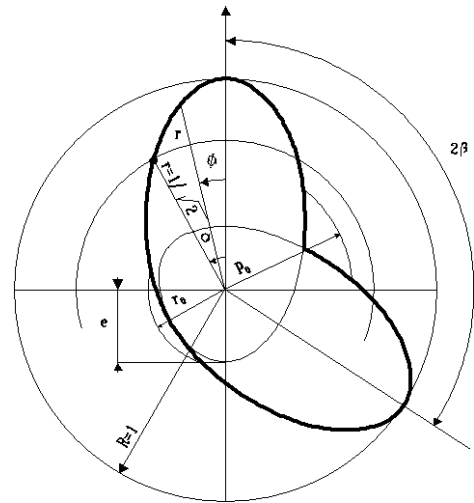
With   m   =   a one-digit number describing the half value of the half-power angle.

        nn =   a two-digit number representing the half value of the angle between the two main beams.

        r   =   a one-digit number characterising the radius of the circle enveloping the side lobes on the back side.

        p   =   a one-digit number characterising the radius of the circle enveloping the side lobes on the front side.

Interpretation and range of the parameters:

$\alpha = m * 5 + 15$ is the half value of the half-power angle.

            $0 \leq \alpha \leq 65^{o}$ is automatically fulfilled because α falls within 15 and 60 degrees due to the range of "m".

$\beta = nn$ is half of the opening angle between the main beams.

            $0 \leq \beta$ There are no limitations on the maximum of the opening angle. However, it is reasonable to limit the half opening angle to be not greater than 90 degrees.

$r_O = r/20$ is the enveloping radius of the side lobes in the back direction.

            $0 \leq r_O < 1.0$ is automatically fulfilled.

$p_O = p/20 + 0.35$ is the enveloping radius of the side lobes in the front direction.

            $0 \leq p_O < 1.0$ is automatically fulfilled.

e   is the shift of the extremity of the ellipses.

            $0 \leq e \leq 1/\sqrt{2}$ is automatically fulfilled.

e	4th and 5th characters of the string
0.00	WA
0.05	WB
0.10	WC
0.15	WD
0.20	WE
0.25	WF
0.30	WG
0.35	WH
0.40	WI

The basic relations are :

IF e=0 THEN e = 1E-5

$$k_5 = \left(\frac{1+e}{2}\right)^2$$

$$b^2 = \frac{k_5}{2} * \frac{1 - \cos^2(\alpha)}{k_5 - \left(\frac{\cos(\alpha)}{\sqrt{2}} - \frac{1-e}{2}\right)^2}$$

$$k_4 = b^2 - k_5$$

$$k_3 = b^2 * e * k_5$$

$$k_2 = b^4 * k_5 - k_3$$

$$k_1 = b^2 * \frac{1-e}{2}$$

$$r_i = \frac{k_1 * \cos(x) + \sqrt{k_2 * \cos^2(x) + k_3}}{k_4 * \cos^2(x) + k_5}$$ The relative gain of the i-th beam (i=1,2)

In the above equations, x is the running angle coordinate of the beams.

r_1=fnct(ϕ)   is the relative gain of beam 1

r_2=fnct(ϕ-2*β)   is the relative gain of beam 2

with ϕ being the current angle

The resulting pattern is formed by taking the maximum from r_1, r_2 and p_0 calculated for any given direction within the angular range of less than 180 degrees between the two main beams and taking the greatest from r_1, r_2 and r_0 calculated for any other given direction.

The field 9A of the data base must contain the azimuth of that main beam axis with respect to which the other one can be reached by a positive angular turn of less than 180 degrees.

Examples of the W type antenna