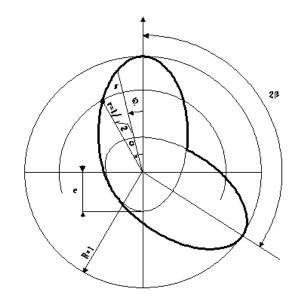## V-type antenna diagrams
(VA, VB, ... VH, VI)

This type of symmetrical radiation pattern diagram has two main beams based on shifted ellipses. The ellipse components may be shifted and their half angle of radiation can be used as parameter. The scale of the shift is expressed by the second letter of the type code. The parameters cannot be specified in the conventional way because of the given format of the type code as well as the determined number of characters being contained in the type code string. Thus, the first group of digits must be divided in two parts so that the code can represent more independent data elements. However, this solution implies that coarser steps of the parameters must be contended with. The half value of the half-power angle can be varied with five-degree steps, its minimum and maximum being 15 degrees and 60 degrees, respectively.

The shift of the ellipses can be specified within the range of 0.00 to 0.40 in 9 steps of 0.05 each.

The notation of the type is   mnnVArr

         …

         mnnV I rr

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

       rr   =   a two-digit number, the value of which is one hundred times the radius of the circle enveloping the side lobes.

Interpretation and range of the parameters:

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

$$0 \le \alpha \le 65^{o}$$ 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.

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

$R_O = rr/100$ is the enveloping radius of the side lobes.

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

e   is the shift of the extremity of the ellipses.

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

e	4th and 5th characters of the string
0.00	VA
0.05	VB
0.10	VC
0.15	VD
0.20	VE
0.25	VF
0.30	VG
0.35	VH
0.40	V I

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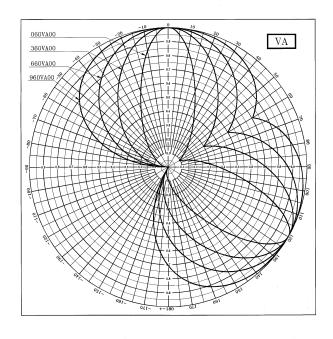
In the above equations x is the running angle coordinate of the beams.

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 r_0 calculated for any given direction.

The field 9A of the database 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 V type antenna