Microwave Memos
Memo 18

Crosseyed Array

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Consider the new numbers of 30 ms pulsewidth for 10 mJ into the approximately 1 Ω target. This implies a power into the target of

$$P_{load} = \frac{I^2}{2R} = \frac{10\,mJ}{30\,ms} = 0.3\,Watts$$
$$I = \sqrt{0.6} \simeq 0.77\,Amps \quad (peak)$$

Assuming a nominal 1 GHz we have from μ wave memo 15

$$E_{inc} = f\,\mu_0 \left[-\ell n\left(\frac{\pi f}{a}\right) - \gamma_e\right] I \quad , \quad a = 1\,mm$$
$$-\ell n\left(\frac{\pi f}{ca}\right) - \gamma_e = \ell n\left(\frac{3 \times 10^5}{\pi 10^8}\right) - 0.577 \simeq 6.28$$
$$E_{inc} = 10^8 4\pi 10^{-7} 6.28 \times 0.77 \simeq 608\,V/m\ (peak)$$
$$p_{inc} = \frac{E_{inc}^2}{2\,Z_0} = \frac{608^2}{2 \times 377} \simeq 490\,W/m^2$$

These required numbers are nominal since the current I induced depends on the geometry.

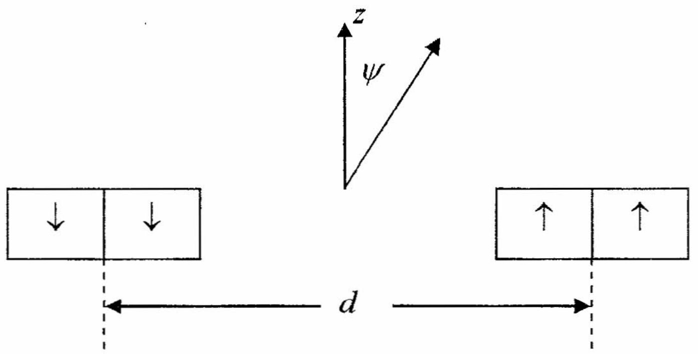
Consider the antenna. Let each waveguide array have six elements. The gain of a single dipole (magnetic in this case) is 1.5. However, radiating into only a half space doubles this to three. Two waveguide arrays then give a gain

$$G = 2 \times 6 \times 3 = 36$$
$$P_{in} = \text{power into array}$$
$$p_{inc} = \frac{P_{in} G}{4\pi r^2}$$
$$r = \left[\frac{P_{in} G}{4\pi P_{inc}}\right]^{1/2} = \text{distance to target}$$

Example 1: $G = 36$, $p_{inc} = 490\ W/m^2$

P_{in}	r
100 kW	24.2 m
300 kW	42.0 m
1 mW	76.5 m

It has been suggested (by. C. Courtney) that the gain could be somewhat larger. This might be associated with a more uniform phase of the field across each subaperture. One could also subdivide each aperture (as in SSN 459) to effectively double the number of subapertures and help suppress sidelobes in the vertical direction. One could also double the number of waveguide arrays, arranged as



This would also help in suppressing some unwanted sidelobes in the horizontal direction.

Example 2: $G = 100$, $P_{inc} = 490\ W/m^2$

P_{in}	r
100 kW	40.3 m
300 kW	70.0 m
1 mW	127.0 m

One can choose various values for G, but this may ultimately need to be measured. Note that there is a factor of $\cos^2(\psi)$ to be included in the gain, but for small ψ, this is not significant. The largest uncertainty is the geometry—specific value of the current in the target.