Note to self: The torus can be thought of as a product of the sets $\{y^2+x^2=1\}$ and $\{w^2+x^2=1\}$. We imagine a torus as a circle rotated around in a circle. The first equation defines our location on the first circle, and the second the second circle.

(3.C) We recall the image of $(S^1 \times S^1)$ is covered twice under F. The length of the tangent vector, we can think of as speed. Our intuition is that F doubles the lengths of all tangent vectors, to cover twice the area in the same time.

We can compare $\sqrt{dp^2+dq^2+dr^2+ds^2}$ and $\sqrt{dw^2+dx^2+dy^2+dz^2}$.

Substitute $\begin{pmatrix} dp = 2p \\ dq = 2q \\ dr = 2r \\ ds = 2s \end{pmatrix}$ and choose a coordinate $\begin{pmatrix} p = 1/\sqrt{2} \\ q = 1/\sqrt{2} \\ r = 1/\sqrt{2} \\ s = 1/\sqrt{2} \end{pmatrix}$ which is convineient.

we have $\sqrt{(2/\sqrt{2})^2 + (2/\sqrt{2})^2 + (2/\sqrt{2})^2 + (2/\sqrt{2})^2} = \sqrt{8} = (dp^2+dq^2+dr^2+ds^2)^{1/2}$

and $\sqrt{2(2/\sqrt{2} \cdot 1/\sqrt{2} + 2/\sqrt{2} \cdot 1/\sqrt{2})^2 \times 4} \Rightarrow \sqrt{32} = (dw^2+dx^2+dy^2+dz^2)^{1/2}$

To find the factor of length expansion by F, we set $\left(\frac{dw^2+dx^2+dy^2+dz^2}{dp^2+dq^2+dr^2+ds^2}\right)^{1/2}$

$\Rightarrow \sqrt{32/8} \Rightarrow \sqrt{4} \Rightarrow \boxed{2}$