Given the electromagnetic field $E(x, y, 0)$ defined in the plane $z = 0$, the field $E(x, y, z)$ in the plane z can be calculated using the Fresnel diffraction integral:

$$E(x,y,z) = \frac{\mathrm{e}^{\mathrm{i}kz}}{\mathrm{i}\lambda z} \iint\limits_{-\infty}^{+\infty} E(x',y',0)\, \mathrm{e}^{\mathrm{i}\frac{k}{2z}\left((x-x')^2+(y-y')^2\right)}\, \mathrm{d}x'\mathrm{d}y' \tag{1}$$

$$E(x,y,z) = E(x,y,0) * h(x,y,z)\ , \tag{2}$$

where

$$h(x,y,z) = \frac{\mathrm{e}^{\mathrm{i}kz}}{\mathrm{i}\lambda z} \mathrm{e}^{\mathrm{i}\frac{k}{2z}(x^2+y^2)} \tag{3}$$

$$(f*g)(x) = \int f(x)\, g(x-x')\, \mathrm{d}x' \tag{4}$$

Since $\mathcal{F}\{f*g\} = \mathcal{F}\{f\} \cdot \mathcal{F}\{g\}$

$$\check{E}(f_x,f_y,z) = \check{E}(f_x,f_y,0) H(f_x,f_y,z) \tag{5}$$

$$\begin{align} H(f_x,f_y,z) &= \mathcal{F}\{h(x,y,z)\} \tag{6}\\ &= \frac{\mathrm{e}^{\mathrm{i}kz}}{\mathrm{i}\lambda z} \mathcal{F}\left\{\mathrm{e}^{\mathrm{i}\frac{k}{2z}x^2}\right\} \mathcal{F}\left\{\mathrm{e}^{\mathrm{i}\frac{k}{2z}y^2}\right\} \tag{7}\end{align}$$

$$\mathcal{F}\left\{\mathrm{e}^{\mathrm{i}\alpha t^2}\right\} = \sqrt{\frac{\pi}{\alpha}}\, \mathrm{e}^{\mathrm{i}\frac{\pi}{4}}\, \mathrm{e}^{-\mathrm{i}\frac{(2\pi f)^2}{4\alpha}} \tag{8}$$

$$\begin{align} H(f_x,f_y,z) &= \frac{\mathrm{e}^{\mathrm{i}kz}}{\mathrm{i}\lambda z} \sqrt{\frac{2\pi z}{k}}\, \mathrm{e}^{\mathrm{i}\frac{\pi}{4}}\, \mathrm{e}^{-\mathrm{i}\frac{4\pi^2 f_x^2 2z}{4k}} \sqrt{\frac{2\pi z}{k}}\, \mathrm{e}^{\mathrm{i}\frac{\pi}{4}}\, \mathrm{e}^{-\mathrm{i}\frac{4\pi^2 f_y^2 2z}{4k}} \tag{9}\\ &= \frac{\mathrm{e}^{\mathrm{i}kz}}{\mathrm{i}\lambda z} \frac{2\pi z}{k}\, \mathrm{e}^{-\mathrm{i}\pi\lambda z f_x^2}\, \mathrm{e}^{-\mathrm{i}\pi\lambda z f_y^2} = \mathrm{e}^{\mathrm{i}kz} \mathrm{e}^{-\mathrm{i}\pi\lambda z(f_x^2+f_y^2)} \tag{10}\end{align}$$

$$H(f_x,f_y,z) = \mathrm{e}^{\mathrm{i}kz} \mathrm{e}^{-\mathrm{i}\pi\lambda z(f_x^2+f_y^2)} \tag{11}$$

$$\check{E}(f_x,f_y,z) = \mathrm{e}^{\mathrm{i}kz} \mathrm{e}^{-\mathrm{i}\pi\lambda z(f_x^2+f_y^2)}\, \check{E}(f_x,f_y,0) \tag{12}$$

Propagate from the SLM plane $E_{\mathrm{SLM}}(x, y)$ to the lense:

$$E^-_{\mathrm{Lense}}(x,y) = \frac{\mathrm{e}^{\mathrm{i}kf}}{\mathrm{i}\lambda f} \mathrm{e}^{\mathrm{i}\frac{k}{2f}(x^2+y^2)} \iint\limits_{-\infty}^{+\infty} E_{\mathrm{SLM}}(x',y')\, \mathrm{e}^{\mathrm{i}\frac{k}{2f}(x'^2+y'^2)} \mathrm{e}^{-\mathrm{i}\frac{2\pi}{\lambda f}(xx'+yy')}\, \mathrm{d}x'\mathrm{d}y' \tag{13}$$

$$E^+_{\mathrm{Lens}}(x,y) = E^-_{\mathrm{Lens}}(x,y) \mathrm{e}^{-\mathrm{i}\frac{k}{2f}(x^2+y^2)} \tag{14}$$

Propagate from $E^{+}_{\mathrm{Lense}}(x,y)$ to the focal plane:

$$E_{\mathrm{Focus}}(x,y) = \frac{\mathrm{e}^{\mathrm{i}kf}}{\mathrm{i}\lambda f}\mathrm{e}^{\mathrm{i}\frac{k}{2f}(x^2+y^2)} \iint\limits_{-\infty}^{+\infty} E^{+}_{\mathrm{Lens}}(x',y')\,\mathrm{e}^{\mathrm{i}\frac{k}{2f}(x'^2+y'^2)}\mathrm{e}^{-\mathrm{i}\frac{2\pi}{\lambda f}(xx'+yy')}\,\mathrm{d}x'\mathrm{d}y' \tag{15}$$

...:

$$E_{\mathrm{Focus}}(x,y) = \frac{\mathrm{e}^{\mathrm{i}kf}}{\mathrm{i}\lambda f}\mathrm{e}^{\mathrm{i}\frac{k}{2f}(x^2+y^2)} \iint\limits_{-\infty}^{+\infty} E^{-}_{\mathrm{Lens}}(x',y')\,\mathrm{e}^{-\mathrm{i}\frac{2\pi}{\lambda f}(xx'+yy')}\,\mathrm{d}x'\mathrm{d}y' \tag{16}$$

$$= \frac{\mathrm{e}^{\mathrm{i}kf}}{\mathrm{i}\lambda f}\mathrm{e}^{\mathrm{i}\frac{k}{2f}(x^2+y^2)}\;4\pi^2\,\check{E}^{-}_{\mathrm{Lens}}(f_x,f_y) \tag{17}$$

$$\check{E}^{-}_{\mathrm{Lens}}(f_x,f_y) = \mathrm{e}^{\mathrm{i}kf}\mathrm{e}^{-\mathrm{i}\pi\lambda f(f_x^2+f_y^2)}\,4\pi^2\,\check{E}^{-}_{\mathrm{SLM}}(f_x,f_y) \tag{18}$$

$f_x = x/(\lambda f),\ f_y = y/(\lambda f)$

$$E_{\mathrm{Focus}}(x,y) = \frac{\mathrm{e}^{2\mathrm{i}kf}}{\mathrm{i}\lambda f}\,4\pi^2\,\check{E}_{\mathrm{SLM}}(f_x,f_y) \tag{19}$$