Polarization and Detector Linearity

We think that a certain microwave detector is linear in electric field, but we are not certain; it could be linear in intensity or not linear at all. Devise an experiment by rotating a polarizer in front of the detector and measuring the detector output as a function of the angle of rotation of the polarizer (which is proportional to time). How "should" the detector respond if it is linear in electric field? If it is linear in intensity? Hints: The microwave source emits a polarized wave. The detector is sensitive to polarization. (Check these claims.) Note: If a microwave detector is linear in amplitude but rectifies the signal, then its output may be the magnitude of a cosine function, rather than a cosine function.

You may find expressions for the wave transmitted by polarizers in your physics II text. One such expression is for the amplitude of the transmitted field, whereas another is for the intensity.

Perform a similar experiment with the optical polarizer. Here, the source, a HeNe laser, is not linearly polarized, so you will need to place a polarizer in front of the laser. The detector itself is not sensitive to polarization. Devise an experiment to ascertain whether the optical detector is linear in intensity.

Be careful; because $\cos 2x = 1 + 2\cos^2 x$, you can always express a cosine function in terms of a cosine-squared function, and vice versa. How many transmission maxima do you expect in each complete rotation of the polarizer?