Constructing genetic logic circuits is an application of synthetic biology in which parts of the DNA of a living cell are engineered to perform a dedicated Boolean function triggered by an appropriate concentration of certain proteins or by different genetic components. These logic circuits work in a manner similar to electronic logic circuits, but they are much more stochastic and hence much harder to characterize. In this article, we introduce an approach to analyze the threshold value and timing of genetic logic circuits. We show how this approach can be used to analyze the timing behavior of single and cascaded genetic logic circuits. We further analyze the timing sensitivity of circuits by varying the degradation rates and concentrations. Our approach can be used not only to characterize the timing behavior but also to analyze the timing constraints of cascaded genetic logic circuits, a capability that we believe will be important for design automation in synthetic biology.