A lattice model $\mathcal{A}_2$ of radiative decay (so-called spin-boson Hamiltonian) of a two level atom and at most two photons is considered. The results for the spin-boson Hamiltonian $\mathcal{A}_2$ with at most two photons are obtained by considering a more general model $H$. The location of the essential spectrum of $H$ and $\mathcal{A}_2$ are described. The lower bound of the essential spectrum of $H$ and $\mathcal{A}_2$ are estimated. Conditions which guarantee the finiteness of the number of eigenvalues of $H$, below the bottom of its essential spectrum are found. It is shown that the discrete spectrum of $H$ might be infinite if the parameter functions are chosen in a special form.