The use of GaAs photoconductive semiconductor switches (PCSS) for generating THz radiation is well known. Both semi-insulating (SI) and Low-temperature (LT) grown Gallium Arsenide (GaAs) have been used. In this research the material parameters that affects the generated pulse shape is studied and compared. Specifically, the role of traps, its density and concentration, carrier rise time, beam width and decay have been analyzed. An industry standard simulation suite was used in the analysis. Study shows that for both LT-GaAs and SI-GaAs there is an increase in total current density with the application of higher bias voltage. Increase in bias increased the drift component through velocity and depletion width increase. Since SI-GaAs have a relatively larger trap concentration at midgap than LT-GaAs and the carrier recombination rate is also higher in SI-GaAs, the linearity the collected charge plot of SI-GaAs is more affected than that of LT-GaAs PCSS. Consequently, charge collection and rise time is faster in LT-GaAs based PCSS as compared to SI-GaAs and will thus transfer more energy to the load than SI based PCSS. The both LT-GaAs PCSS and SI-GaAs PCSS, the role of traps is an important factor that determines the generated pulse shape and width. Specifically effects of recombination rate, beam width and decay and carrier rise time influences the current density and the shape of THz pulse generated. Further, it was observed that LT-GaAs based photoconductive semiconductor switches have superior resistivity (breakdown fields) and charge collection values when compared to SI-GaAs based photoconductive semiconductor switches.