

# **Modeling BJT Transistor Small Signal Response for Advanced Driver Assistance Systems (ADAS) Using Miller Effect**

24 Jul 2017

Cliff Mosiori and John Maera

## **Abstract**

Miller effect was named after John Milton Miller. When Miller published his work in 1920, he was working on vacuum tube triodes. This Miller Effect theory applies to more modern semiconductor fabricated devices including bipolar transistors, and MOSFET where they are assumed to be affected by Miller capacitance. Miller capacitance was first identified in 1920 in triode vacuum tubes by John Milton Miller. Based on Miller's work then, Miller Effect refers to capacitance, or any impedance connected between an input node and another node exhibiting a gain which can modify the input impedance of an amplifier through its effect. Miller Effects are generalized using a theorem referred to as the Miller theorem. In this theorem, Miller capacitance is caused by the parasitic capacitance between the output and input of active devices like transistors and this forms a major factor limiting their gains at high frequencies. Miller effect therefore, accounts for an increase in the equivalent input capacitance of an inverting voltage amplifier due to amplification of capacitance between the input and output terminals. Automated control systems are becoming more common in new road vehicles. Automation is designed to assist with mechanical or electrical accomplishment of tasks. It involves actively selecting and transforming information, making decisions, and/or controlling processes. Automated vehicle control systems are intended to improve safety, comfort, traffic efficiency, and the environment. The automation of basic control functions has proven very effective, but the safety implications of more advanced systems. It is controversial that system safety will always be enhanced by allocating functions to automatic devices rather than to the drivers. Automating out-of-loop performance has widely used transistors as a potential automating device. This has lead to the use of Advanced Driver Assistance Systems (ADAS) that employs the use sensors and complex signal processing devices to detect and evaluate the vehicle environment to provide active support for lateral or longitudinal control, information, and warnings. Tasks carried out by ADAS range from information to collision avoidance and vehicle control. All these devices required well designed transistors so that warnings and control operations play an efficient safety enhancement. In this work, we develop transistor small-signal model for high frequencies and used it to find the high-frequency response of elementary transistor circuits for the BJT transistors.

Keywords: Miller Effect, Advanced Driver Assistance Systems, Underload, Underload, Automation