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"Negative group delay active topologies respectively dedicated to microwave frequencies and baseband signals"

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Abstract – This paper proposes and describes in details the synthesis, design and implementation of two different active topologies exhibiting negative group delay (NGD) in different frequency bands. With the first of them, gain and NGD in microwave frequency band are simultaneously achieved; the basic cell consists in a field effect transistor (FET) cascaded with a shunt RLC series network. The second topology brings also gain and NGD but is particularly dedicated to baseband signals; this circuit is also built with a FET; but this time in feedback with an RL series network. For both approaches, analytical formulas demonstrating the existence of gain and NGD are proposed together with details about the associated equations, at first for a single cell and then for multi-stage circuits. After implementation of each topology in a two-stage configuration, the results from experiments in frequency-domain are carefully compared to those from simulations; the same thing is done in time-domain for the baseband-dedicated device. Time-domain simulations and measurements highlight the high capability of both topologies to compensate or control various dispersive effects. Indeed for both circuits, in case of Gaussian-pulse or -modulated signal, the maximum of the output signal exhibits a time advance compared to the input one of respectively more than 40% and 60% of the standard deviation of the input signal. Moreover, this high relative time-advance is obtained with gain and a pulse compression phenomenon.