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(54) **CASCADED LOW-NOISE WIDEBAND
ACTIVE PHASE SHIFTER**

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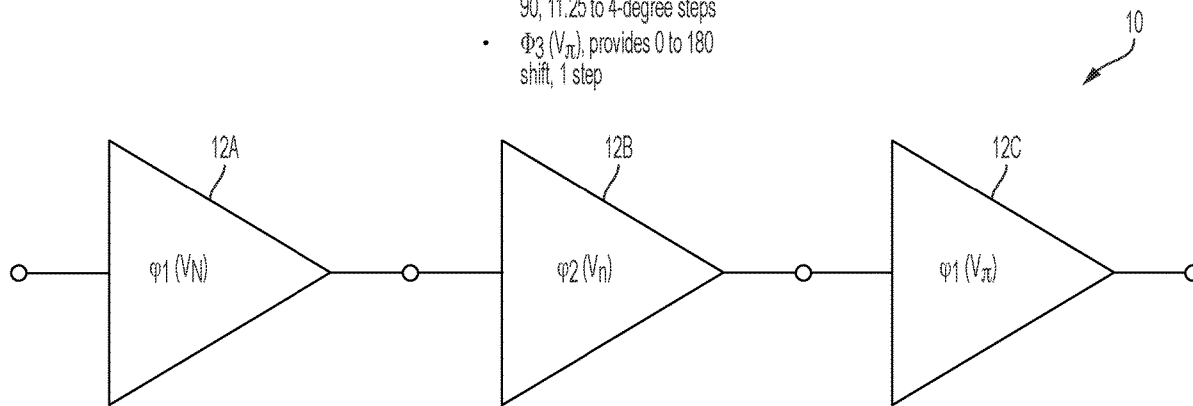
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(57) **ABSTRACT**

Apparatus and associated methods relate to a low-noise wideband active phase shifter. The low-noise wideband active phase shifter includes first and second transconductance cells, a fixed LC series network and a tunable LC series network configured to form an all-pass lattice network. The first and second transconductance cells, each include a transistor, a feedback network, and a transistor biasing network. The transistor has an input terminal and an output terminal. The negative feedback network electrically couples the input and output terminals of the transistor. The biasing network provides input and output biasing of the transistor. The fixed LC series network connects between the first and the second transconductance cells. The tunable LC series network connects between the first and the second transconductance cells.

Three-Stage Configuration

- $\Phi_1 (V_N)$, provides coarse tuning 0-180, 45-degree steps
- $\Phi_2 (V_N)$, provides fine tuning 0-90, 11.25 to 4-degree steps
- $\Phi_3 (V_\pi)$, provides 0 to 180 shift, 1 step



$$\text{Noise Factor, } F = F_1 + \frac{F_2 - 1}{GA_1} + \frac{F_3 - 1}{GA_1 \cdot GA_2}$$