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(54) **ANALOG TO DIGITAL CONVERTER WITH VCO-BASED AND PIPELINED QUANTIZERS**

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(57) **ABSTRACT**

An analog-to-digital converter ("ADC") includes an input terminal configured to receive an analog input signal. A first ADC circuit is coupled to the input terminal and includes a VCO. The first ADC circuit is configured to output a first digital signal in a frequency domain based on the analog input signal. The first digital signal includes an error component. A first DAC is configured to convert the first digital signal to an analog output signal. A first summation circuit is configured to receive the analog output signal, the analog input signal, and a loop filtered version of the analog input signal and extract the error component, and output a negative of the error component. A second ADC circuit is configured to convert the negative of the error component to a digital error signal. A second summation circuit is configured to receive the first digital signal and the digital error signal, and to output a digital output signal corresponding to the analog input at an output terminal.