Wideband Front-End

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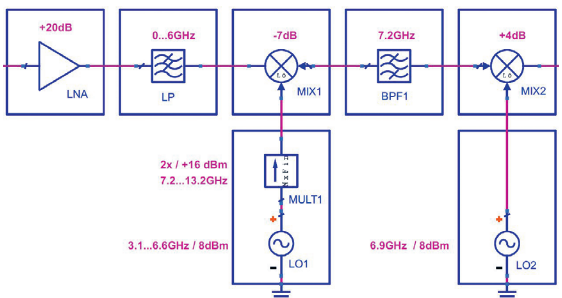
For the reception of radio frequencies, signals such as LTE mobile communication, by using an existing Software Defined Radio SDR, a frequency converter has been developed. Applying the concept of a dual-conversion superhet, a modular prototype has been produced and the results have been evaluated with suitable measurements. 1

The objective was to extend the frequency range of a given Software Defined Radio to the ambitious range from 700 MHz to 6 GHz. With a bandwidth of 200 MHz the input signal has to be mixed down to an intermediate frequency range of the subsequent SDR. The final integration of the design on one PCB was pursued troughout the development process.

Schematic

For an improved dynamic input range a Low Noise Amplifier was used directly at the input. Prevalent mirror frequencies were then filtered from the signal so that they could be mixed up to the first intermediate frequency at 7.2 GHz. The mixer is driven by a synthesizer with an additional active doubler and thus reaches output frequencies up to 14 GHz. While being fully digitally configurable the synthesizer can dynamically be adjusted through the connected SDR to receive any other frequency band. The first intermediate frequency is then filtered with a highly selective filter to meet the bandwidth requirements of 200 MHz. After being mixed down with the second stage mixer and synthesizer to the center frequency of 300 MHz, the modulated signal can directly be digitalized by the SDR and as a result, all demodulation processes can be implemented digitally. This design approach offers a high flexibility in several areas of application. For example, by using an appropriate software library, the reception of every wireless mobile communication standard is generally possible.



Block diagram of the design that was developed

Layout

To provide additional insights into the performance of the system that was developed, a modular setup was used. This way, every module could be measured in standalone operation and the module›s own contribution to the overall performance could be verified. The modules are partitioned according to the figure beside. The biggest challenge for the layout design was to meet RF requirements for every RF signal path. Successfully designing this layout without any previous experience on this process required consulting a lot of reference designs, reading application notes and directly consulting the manufacturer about any questionable parts. The final design is now based on a 4 layer stack up with a standard glass-reinforced epoxy core FR4. To ensure consistent impedance for the signal path a RF prepreg was used between the top layer and the underlying first inner layer. Much attention had to be spent on the output path of the first synthesizer MIX1 since it carries frequencies up to 14 GHz. Therefore, a carefully placed shielding and a smoothly routed track were crucial.

Prototype Manufacturing

Due to the non-standardized layer stack up a manufacturer had to be found who could produce the PCBs within an appropriate timeframe to ensure that the PCBs can still be assembled, tested and evaluated with measurements within the short timespan of the bachelor thesis. Locating a manufacturer within a short time span proved to be quite challenging.

Prospect

The output of the presented work contains all of the production data needed to integrate the prototype design into a single front-end PCB. Valuable experience regarding production has been gained, which sets a milestone in the process of developing an integrated wide-band front-end.

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