In a journey towards the 5G standard, the industry is forging ahead with increasing bandwidth to prepare for the inevitable increase in Internet traffic. The present spectrum in use will not be able to handle the necessary bandwidth for LTE-A into 5G. The industry is examining the use of higher frequency spectrums even into millimeter waves. Other idea possibilities are the use of unlicensed 5.8GHz terrestrial stations and even existing low-orbit satellites circling the earth. To meet these needs we will need better performing mixers than we have now.

What about using Microwave Mixers?

Most microwave mixers are designed with discrete GaAs diodes or FETs in hybrid modules. Linear Technology’s LTC5549 is constructed using a very high frequency advanced SiGe BiCMOS process. Linear designers have been able to achieve high integration, including an on-chip LO buffer and microwave balun transformers. The die is monolithic and the construction is flipped and soldered onto a 3mm x 2mm lead-framed, plastic QFN surface mount package. Designers have been able to eliminate inductive bond wires that will extend the device’s microwave frequency. This compact package and the minimum external circuitry needed really reduces the board footprint and increases precious board space for other parts of the design. See Figure 1.
Figure 1: The LTC5549 is a possible solution for the path to 5G

This mixer offers 22.3dBm typical IIP3, which is 4 to 6 higher IIP3 than the traditional microwave-type mixers as well as 24.4 dBm IIP3 at 9GHz.

Along with the device’s integrated LO input buffer that only a 0dBm LO drive, this effectively eliminates an external amplifier circuit, reducing costs. Also this is an advantage compared to the traditional microwave mixers that typically need an external high power LO buffer amplifier, requiring +10dBm to +17dBm power levels. The high power signal not only creates LO leakage to the RF or the IF ports, thus requires more filtering to keep it under control, but also it is an undesirable radiating source that is prone to couple to other sensitive parts of the system.

Better Bandwidth Drives future Internet Speed needs

Next generation wireless equipment will need to push bandwidth higher, from more than 100MHz at the access point to as high as 1GHz at the backhaul. At these bandwidths, new frequency bands will have to be tapped and transceiver devices will be needed to support it. Right now 4G LET has less than 60 MHz bandwidth where 5G LTE-A will require greater than 100 MHz, even to 1 GHz. Present 4G operates in the 700 MHz to 2.6 GHz bands while 5G LTE-A will operate in the 3.6 GHz, 5.8 GHz,
14 GHz and maybe even higher to attain the needed faster internet speeds.

This double-balanced mixer is able to operate either as an upconverter or downconverter, with a very wide RF frequency range from 2GHz to 14GHz. See Figure 2.

![Figure 2: A system block diagram for expanding the radio frequency range to 14 GHz](image)

The mixer has an integrated on-chip, switchable frequency doubler for LO signal, providing an option to use lower cost, commonly available low frequency synthesizers. The device also has a wideband integrated balun transformer optimized to extend RF frequency bandwidth from 2GHz to 14GHz while enabling single-ended operation. Its IF port also has wide bandwidth up to 6GHz. All three ports are 50Ω matched. The mixer offers high port-to-port isolation, minimizing undesirable LO leakage, and easing external filtering requirements.

**Applications**

The LTC5549’s performance can handle a wide range of microwave applications including microwave backhaul, high unlicensed band LTE-Advanced base stations, satellite broadband radios,
radar systems, X-band and Ku band transceivers, test equipment and satellite modems. The mixer’s excellent conversion loss and IIP3 will make it possible for designs to meet performance levels for these applications. See Figure 3.

Figure 3: Conversion loss and IIP3 (Low side LO, IF = 1890MHz)
ESD

Its improved ESD protection with its 2,000V ESD human body model (HBM) rating on all pins increases reliability.

Temperature range

The device is rated for operation from -40°C to 105°C case temperature to support extended environmental operating temperature.

Power supply and current draw

The mixer is optimized for single 3.3V supply operation, drawing a nominal supply current of 115mA. Additionally, the LTC5549 has an enable pin to disable the IC. When deactivated, the device draws only 100μA maximum standby current. The enable pin can be driven directly to turn the device on and off rapidly in less than 0.2μs, supporting time-division duplex (TDD) or burst mode type radios.
**Pricing**

The LTC5549 is priced starting at $9.50 each in 1,000-piece quantities.

For more information, visit [www.linear.com/product/LTC5549](http://www.linear.com/product/LTC5549).