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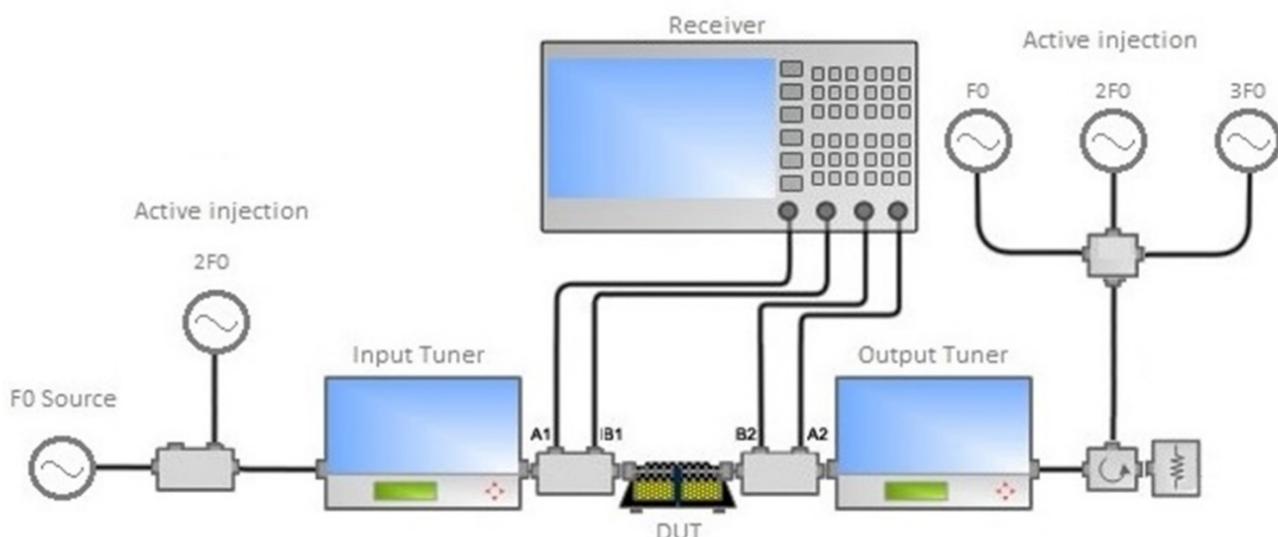
Harmonic Hybrid Active tuning

Hybrid Active Injection Load Pull (**HAILP**) has been introduced by Focus Microwaves in 2012. Since then, PA designers all around the world have adopted HAILP to characterize their devices using this cutting edge technique. Information about fundamental tuning with HAILP can be found in earlier Focus newsletter: http://focus-microwaves.com/news/newsletter-november-2012-hailp

Passive multi-harmonic tuners have similar performance at harmonic frequencies and fundamental. This includes tuning range limited by the performance of the tuner, and more importantly, by the loss of any interconnect hardware with the device under test - Test fixture, cables, probes, PCB...etc -

HAILP systems tuning technique allows to match the most extremely low internal impedance of power transistors at both fundamental and harmonic frequencies*.

The figure below illustrates a setup of hybrid **harmonic injection source and load** pull system that allows RF power transistor characterization also at second harmonic ($2f_0$) at the input and second ($2f_0$) and third ($3f_0$) harmonics at the output simultaneously in addition to the fundamental signal (f0). Both input and output tuners are Focus's multi-purpose tuners (MPT) which are capable of harmonic tuning at frequencies up to 65GHz. A vector receiver measures incoming waves (a1 and a2) and outgoing waves (b1 and b2) using the two directional couplers to the left and right of the device under test. These waves are subsequently used to compute the reflection factors (Γ) presented to the DUT at all frequencies f_0, $2f_0$ and $3f_0$. A wideband high power ferrite circulator is used at output to simultaneously allow injecting active signals from output active injection sources to the DUT (thus enhancing the a2 wave) and terminating the signal from the DUT (b2 wave) into a matched load.

*: Providing the necessary hardware to inject the right power level to reach the target impedance.

News and events

- **IMS 2014**

Focus would like to sincerely thank everyone who stopped by our booth last June in Tampa.
We also wish to congratulate all winners of iPad mini®'s at the daily Focus draws.

- **NEW PATENT: Calibration and Impedance Synthesis Algorithm for Wideband Tuners**

A calibration and impedance synthesis method applies to automatic multi frequency-range electro-mechanical impedance tuner which cover frequencies from a low megahertz to a high gigahertz range; this is possible by cascading a high frequency tuner module with one or two low frequency tuner modules; .....read more

- **FDCS V 2.7C**

Following the 2.7 version release last March. The 2.7C patch is now available for eligible users upon request.
Contact us for more information

Source Active Injection

It has been observed that RF power transistors when operating in nonlinear regime generate harmonic $2f_0$ power at the input. Our understanding of genuine Source Pull is to be able to scan any user defined impedance presented to the device at its input terminals. This is beyond simply matching the device using the measured Γ_{in}, or predicting its behavior using calculations, based on assumptions of unilaterality, as has been reported elsewhere and declared as being active source pull.

HAILP uses the fact of the DUT generating harmonic power at its input terminal to synthesize reflection factors up to $|\Gamma|=1$ at $2F_0$ at the source in a real Source Pull operation.

Just like load tuning with HAILP, the algorithm involves synthesizing an intermediate gamma at $2f_0$ using the passive tuner (MPT or MPT-LITE series) and then injecting power into the input of the DUT at a specific phase optimized such that the target Γ is reached with the least active injection power (see figure above).

This utility was commercialized by Focus Microwaves earlier in 2014, and is already in use worldwide in several labs.

Recent work at customers' sites matching transistors at the input (source) with hybrid harmonic injection has resulted in significant increase in efficiency.

Contact us for more information

Focus Microwaves products are backed by expertise, service and support second to none!

Send your requirements