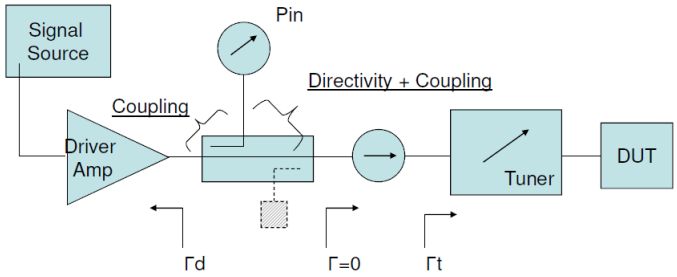
Input Power Calibration for avoiding input Isolator

Power Calibration in Load Pull Measurements

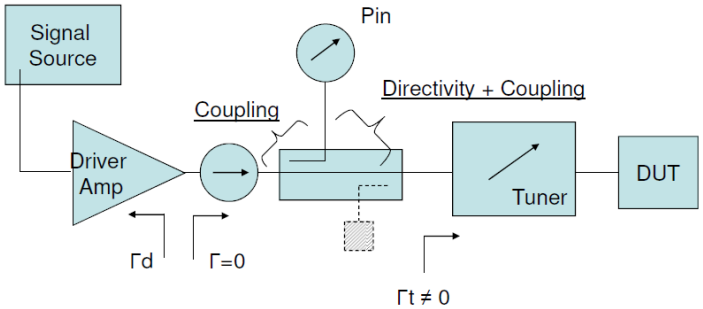
Summary:
It is possible to eliminate the input coupler and isolator used in a traditional load pull setup by using the "power calibration" technique. Here are the possible implications and suggestions.

Traditional setup



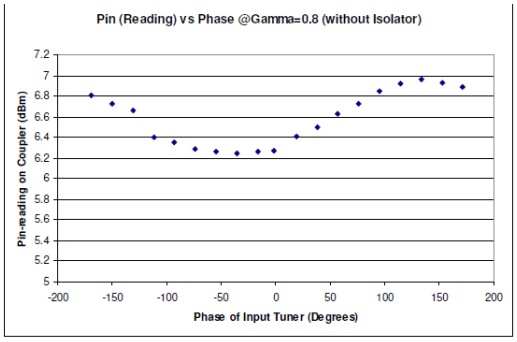
In this configuration the coupler (and the Driver Amp) see always a 50Ω load (Isolator) and the Pin reading does not change, when the tuner moves. The disadvantage is that the Isolator has limited bandwidth and high S22 outside the operation frequency band.

Isolator after the Driver Amp



In this case the non-infinite Directivity of the Coupler will create a reading error at the coupled port: Pin. This is shown on the next slide. The Driver Amp sees always 50Ω.

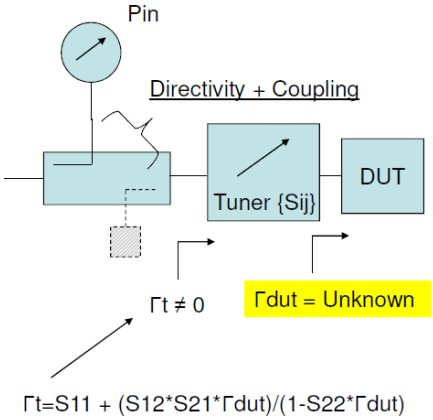
Effect on Pin-Reading



Whereas the source power remains constant the power reading at the input coupler changes about 0.8dB when the tuner completes a 360°circle at T =0.8. This is an unacceptable measurement error.

Is Correction possible?

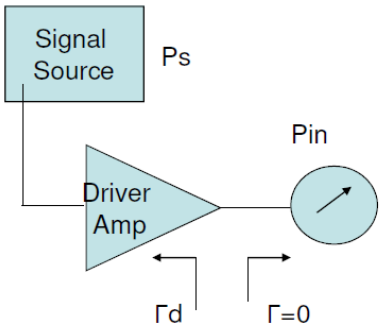
It can be argued that, if we measure 4-port s-parameters of the Coupler, we may be able to correct for the Directivity error.
This is not possible, because DUT Pin Directivity + Coupling Competing through Innovation 5 the Reflection Factor Tt, presented to the output port of the Coupler depends on the large signal of the input impedance of the DUT, Tdut, on the other side of the source tuner, which is unknown.



Power Calibration

Another possibility is to measure the power available at the input port of the source tuner as a function of the signal source power and save the data in a “power calibration file”.
Recalling the power data at each setting of the signal source will provide the power injected (available) at the source tuner.

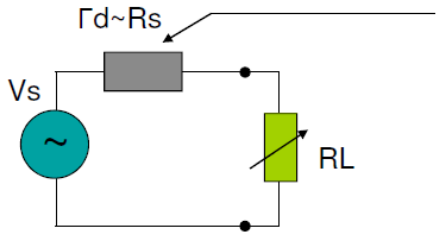
Power Calibration; Pin = f(Ps)



Conditions for Power Calibration

Power Calibration can be used without measurement error, if the signal source (or Driver Amplifier) do not change their output impedance when the load changes.

- This is because the "Power Calibration" is performed on a 50Ω load (power meter sensor)
- During load pull, however, the source tuner and DUT present a variable, non 50Ω, load (RL).

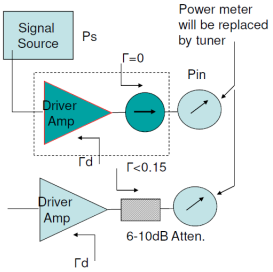


ONLY if Rs does not change with RL can Power Calibration be applied. If it does change, then an Isolator or attenuator needs to be inserted after the Driver Amp, to keep RL=50Ω

Equivalent Circuit of Signal Source and Tuner

Corrected Power Calibration

- It is possible, therefore, to perform a power calibration without measurement error, if we include an Isolator or an attenuator after the Driver Amp.
- An attenuator will keep the VSWR created by the source tuner low, increase instantaneous band-width, but will increase the power requirement of the Driver Amp.



Conclusion

• The Load Pull setup can be simplified and made more wideband by eliminating the input coupler and isolator.
•This is possible only if we use a source (or driver amp) which does not change its output impedance for a variable load.
•If the output impedance changes, then an isolator or VSWR
•If the output impedance changes, then an isolator or VSWR reducing attenuator must be used (6 to 10dB) after the driver amp.
•Using a Driver Amp followed by an Isolatorand eliminate the coupler is the best compromise, since, in general, high power amplifiers cover similar bandwidths as Isolators.