

FOCUS MICROWAVES

HAILP – Hybrid Active Injection Load Pull System

1. Introduction

This manual describes the calibration and configuration required to perform Hybrid Active Injection Load Pull (HAILP).

There are two main components of a HAILP system:

- Travelling wave-based measurements
- Output RF signal injection for active tuning

For travelling wave-based measurements, the system can use one of the following methods (time domain analyzers):

- Agilent PNA-X NVNA measurements (PNA-X Option 520,510, 514, 518)
- 8-term measurements using Agilent PNA-X or R&S ZVA – this is the recommended method

The Active Injection can be implemented using one of the following instruments:

- Agilent PNA-X (PNA-X Option 080 and 088)
- Agilent MXG, PSG
- Anritsu MG3692
- R&S ZVA

The generic HAILP system is composed as follows:

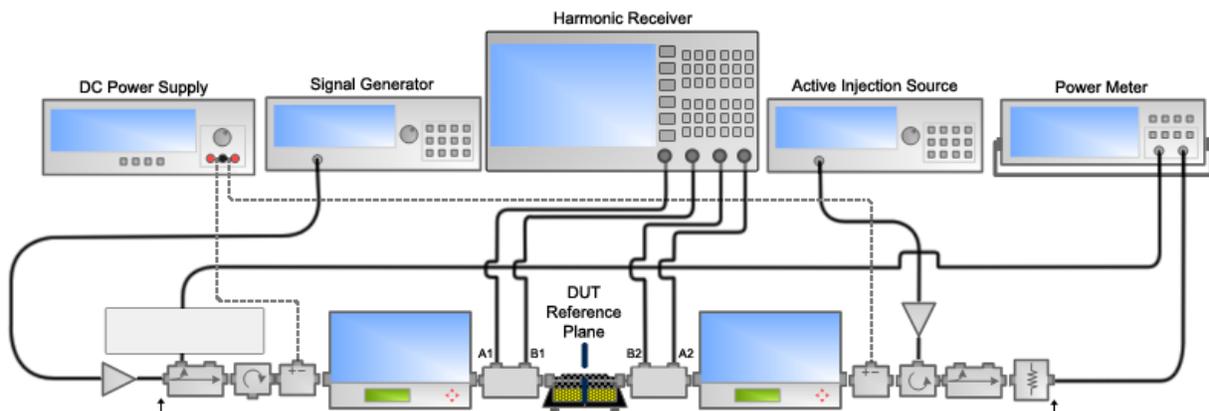


Figure 1: Generic HAILP system

The connection to a power meter is purely for verification purposes and is not required. All power measurements are performed using the time domain analyzer. Output power meter readings are incorrect when the active injection source is ON.

The HAILP system using the PNA-X as time domain analyzer as well as input RF source and active injection source would be connected as follows:

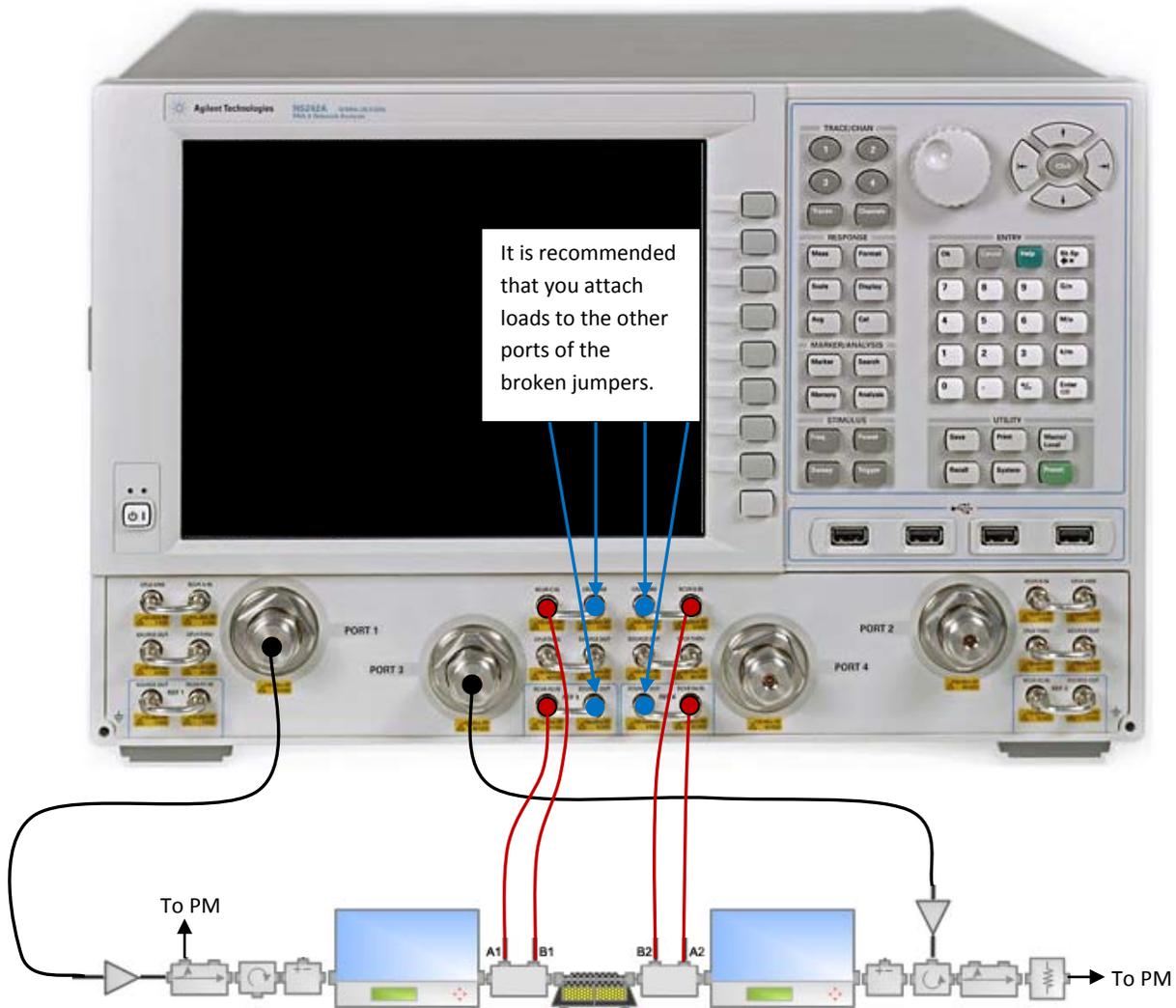


Figure 2: HAILP setup using a PNA-X

2. System Calibration

1. The user must first determine the required attenuation on each of the four couplers paths (A1, B1, A2 and B2) so that the instrument receivers are not overloaded when the device is added and tested. Normally a higher attenuation is used on the output coupler. It is important to keep in mind that the attenuation cannot be so high that the couplers cannot be calibrated and verified (without DUT).

2. Calibrate the input and output tuners (same frequency list for both tuners).
3. Calibrate the s-parameters of setup components: input termination, input block, fixture (with input and output coupler included), output block and output termination.
4. For NVNA method: Perform the NVNA calibration. See the PNA-X NVNA Configuration and Measurement Procedure.
5. For the 8Term method: Calibrate the VNA in the DUT reference with the receivers connected to the couplers – the tuners can be included or excluded in this step depending on whether the user is on-wafer or fixture:
 - a. When using the PNA-X, a 2-port s-parameter calibration is performed on port 3 and 4. See setup below:

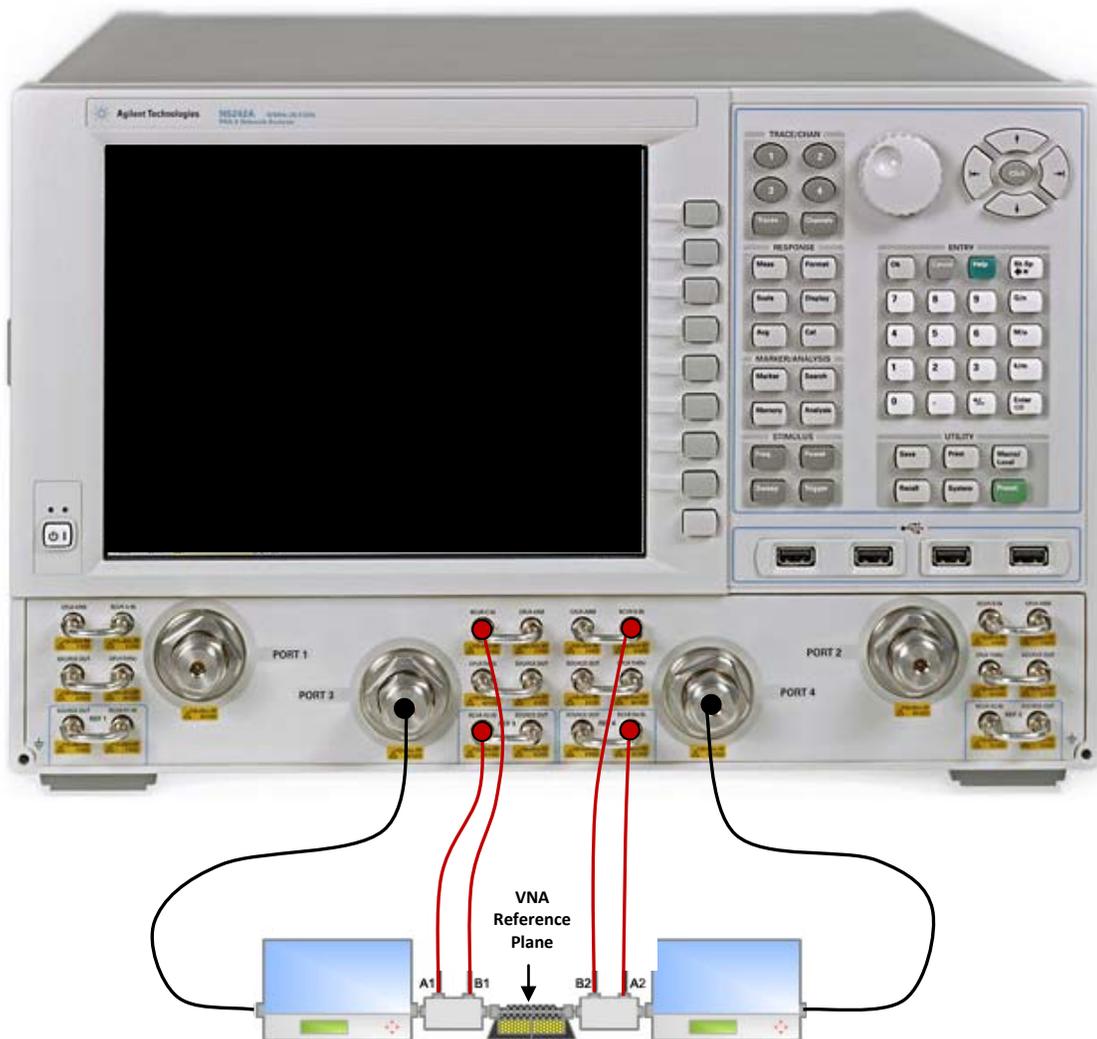


Figure 3: VNA S-parameter calibration

6. For the 8Term method: Perform the power calibration. Open the power calibration dialog by clicking the  icon.

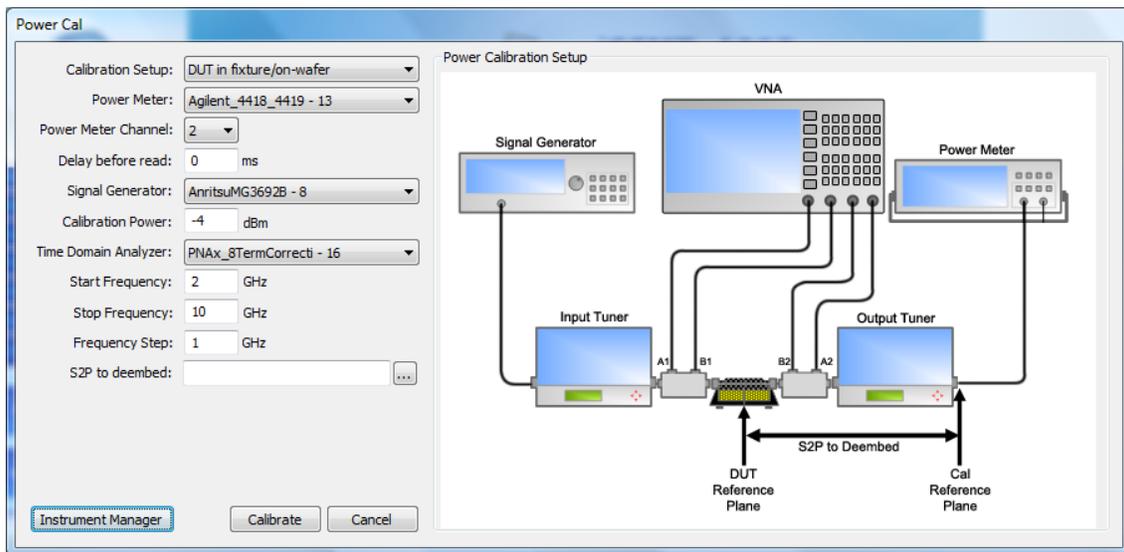


Figure 4

- a. Select the instruments to be used for the power calibration.
 - b. Again for the power calibration, the tuners can be included or excluded in this step depending on whether the user is on-wafer or fixture. For an on-wafer setup, the s2p file to de-embed will be the CONB file used for input tuner calibration and the power sensor is attached to the output of the load tuner. For a fixture setup, it would be easier to connect the power sensor to the output of the output wave coupler and select the fixture output file as the file to de-embed to the DUT reference.
 - c. Select the frequencies to calibrate. It should match the tuner calibration frequency list.
 - d. The calibration power should be high enough to obtain accurate readings on the receivers.
7. Select the following measurements and stimulus in the Measurement Editor:
 - a. RF Source: This can be any signal generator. If you are using the PNA-X port 1; for 8Term method, use the SignalGenerator.PNAX_Opt080 driver; for NVNA method use SignalGenerator.AgilentNVNA.
 - b. Active Injection: There are two available drivers for this instrument the Anritsu 3692B or the PNax (using port 3).
 - c. Wave measurements (PinWaves, PoutWaves, ...): For the Time domain analyzer, if you are using the PNA-X, for 8Term method, use TimeDomainAnalyzer.PNax_8TermCorrection, for NVNA method, use TimeDomainAnalyzer.PNaxNVNA (or TimeDomainAnalyzer.PNaxNVNA_NoDeembed). If you are using the R&S ZVA, select the TimeDomainAnalyzer.RS_ZVA_8TermCorrection driver.