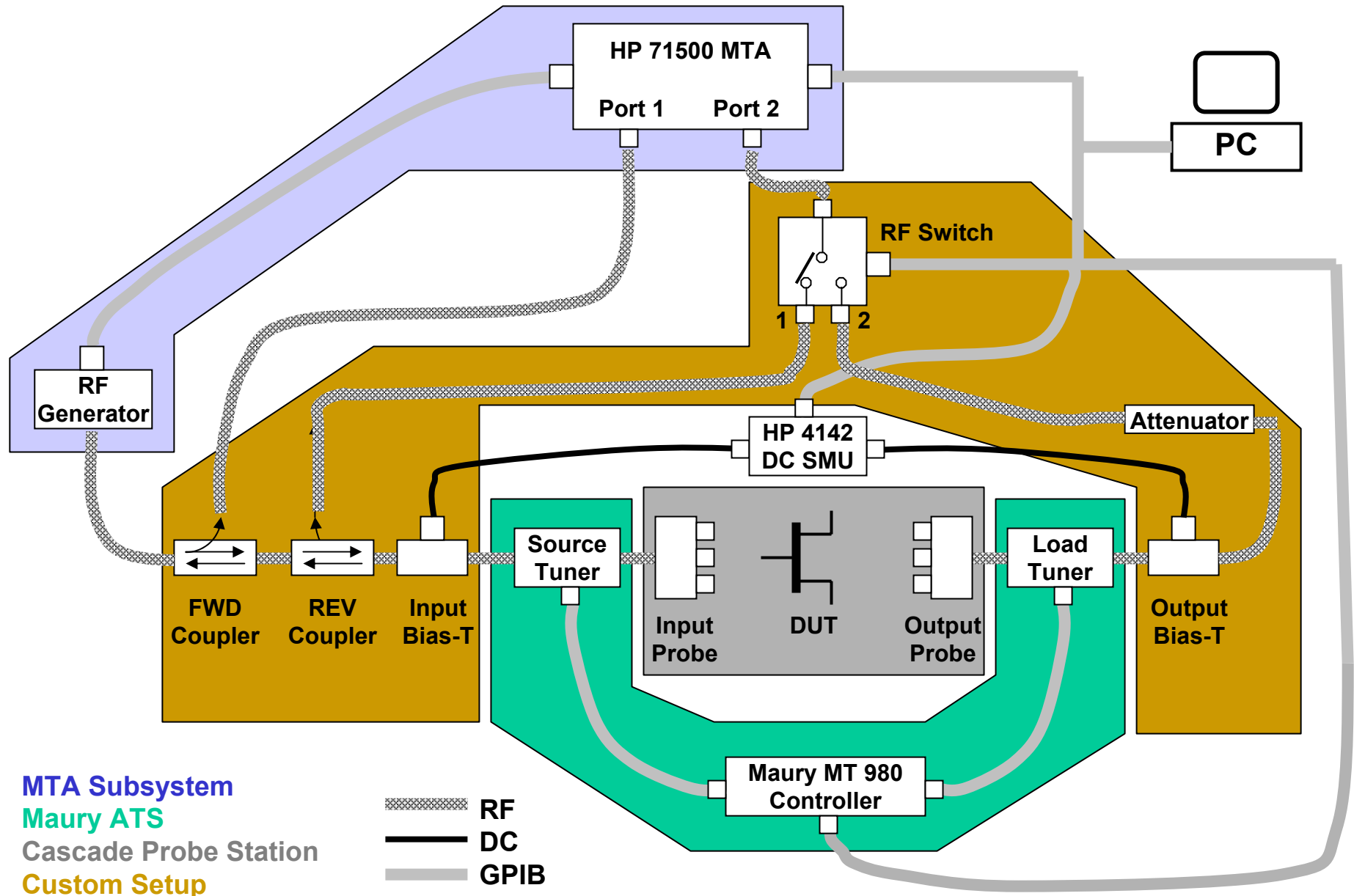


# **Adopting Maury MT980 ATS for On-Wafer Load- and Source-Pull Waveform Measurements Using HP71500 MTA**

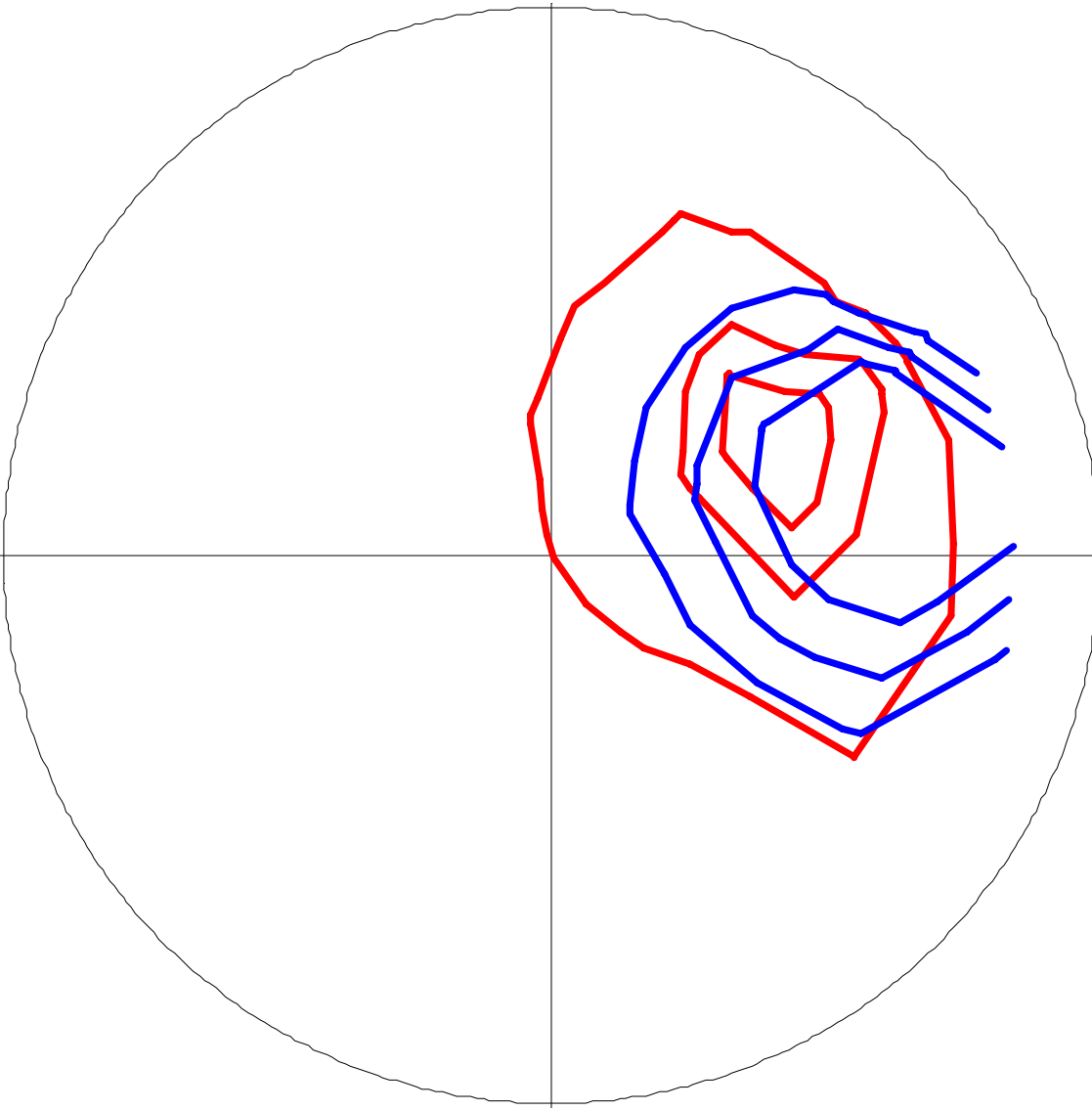
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Lehigh University  
Bethlehem, PA

# Measurement Setup



# Load-Pull Data: Transducer Gain & PAE

This data can be obtained using scalar measurements



**60  $\mu\text{m}^2$  InGaP HBT,**  
**Class-B PA:  $V_{CC} = 3.2$  V**  
**Fundamental  $f_0 = 1$  GHz**  
**Source Impedance 50  $\Omega$**

**Max. Gain: 19 dB**

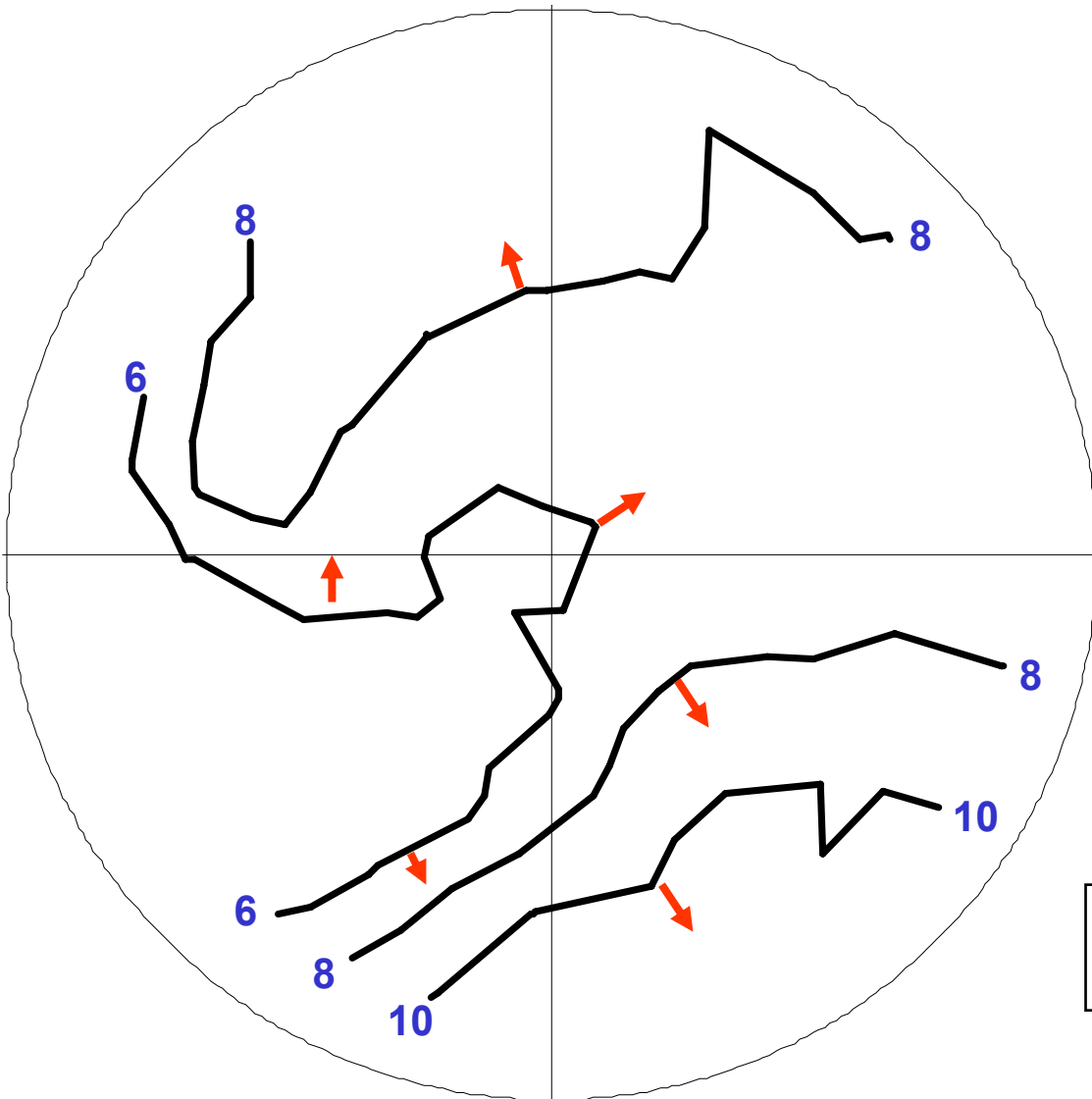
**Contours on  $\Gamma_L$  plane:**

**$G_T$ : -0.5, -1, -3 dB**

**$PAE$ : 60, 50, 40 %**

# Load-Pull Data: Maximum $V_{CE}$

This data **cannot** be obtained using scalar measurements

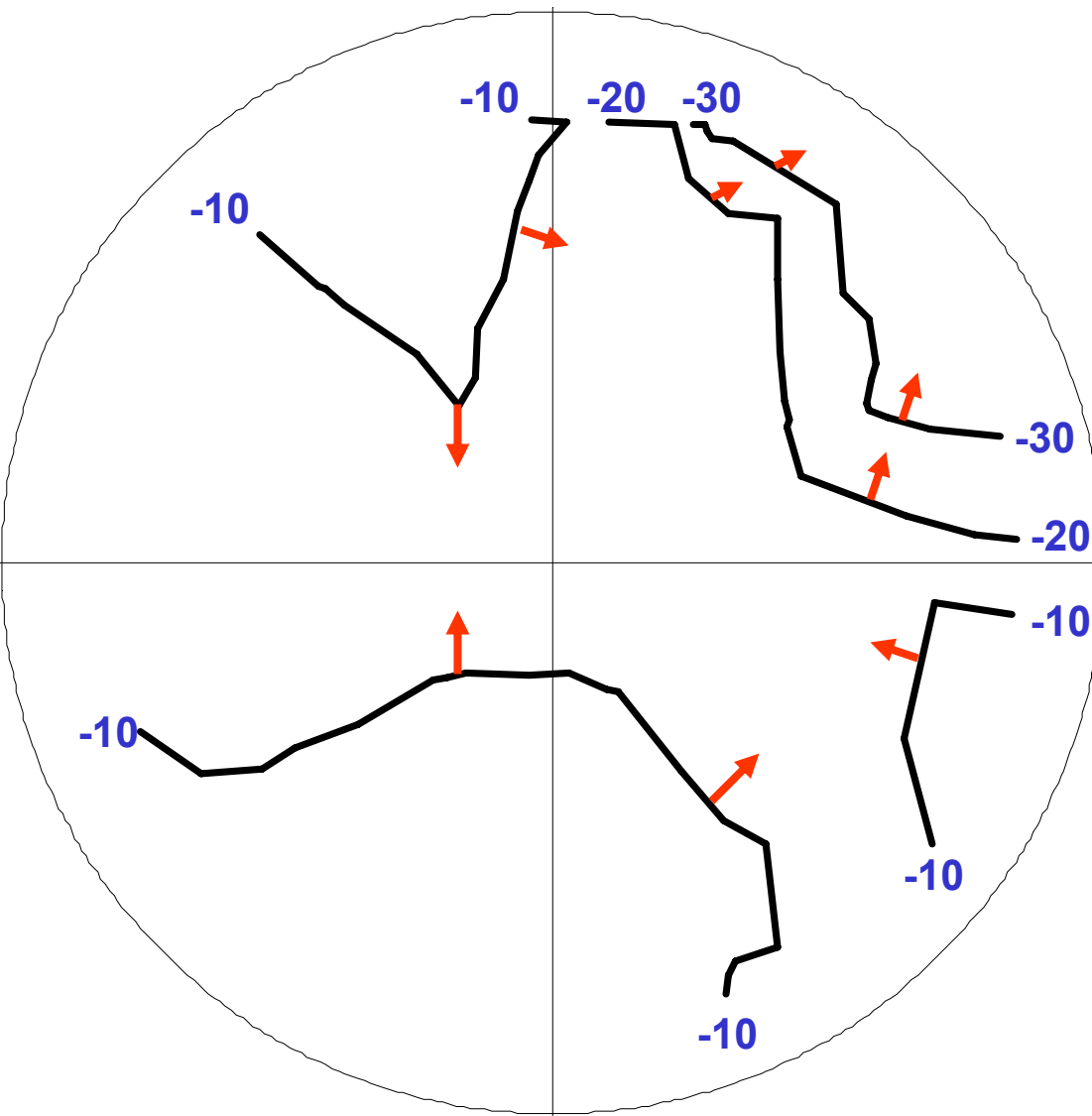


60  $\mu\text{m}^2$  InGaP HBT,  
Class-B PA:  $V_{CC} = 3.2$  V  
Fundamental  $f_0 = 1$  GHz  
Source Impedance 50  $\Omega$   
Contours on  $\Gamma_L$  plane:  
 $V_{CE,MAX}$ : 10, 8, 6 V

→ Increase of  $V_{CE,MAX}$

# Load-Pull Data: Phase Distortion

This data **cannot** be obtained using scalar measurements



**60  $\mu\text{m}^2$  InGaP HBT,**  
**Class-B PA:  $V_{CC} = 3.2 \text{ V}$**   
**Fundamental  $f_0 = 1 \text{ GHz}$**   
**Source Impedance  $50 \Omega$**   
**Contours on  $\Gamma_L$  plane:**  
*Phase @  $f_0$ : -30, -20, -10*

**→ Increase of (-Phase)**

# Issues

## ➤ Calibration

- In situ, frequency domain
- The source tuner screens off the DUT
  - ⇒ cannot always use on-wafer SOL standards
- Solution - use the load tuner as a calibration standard 😊

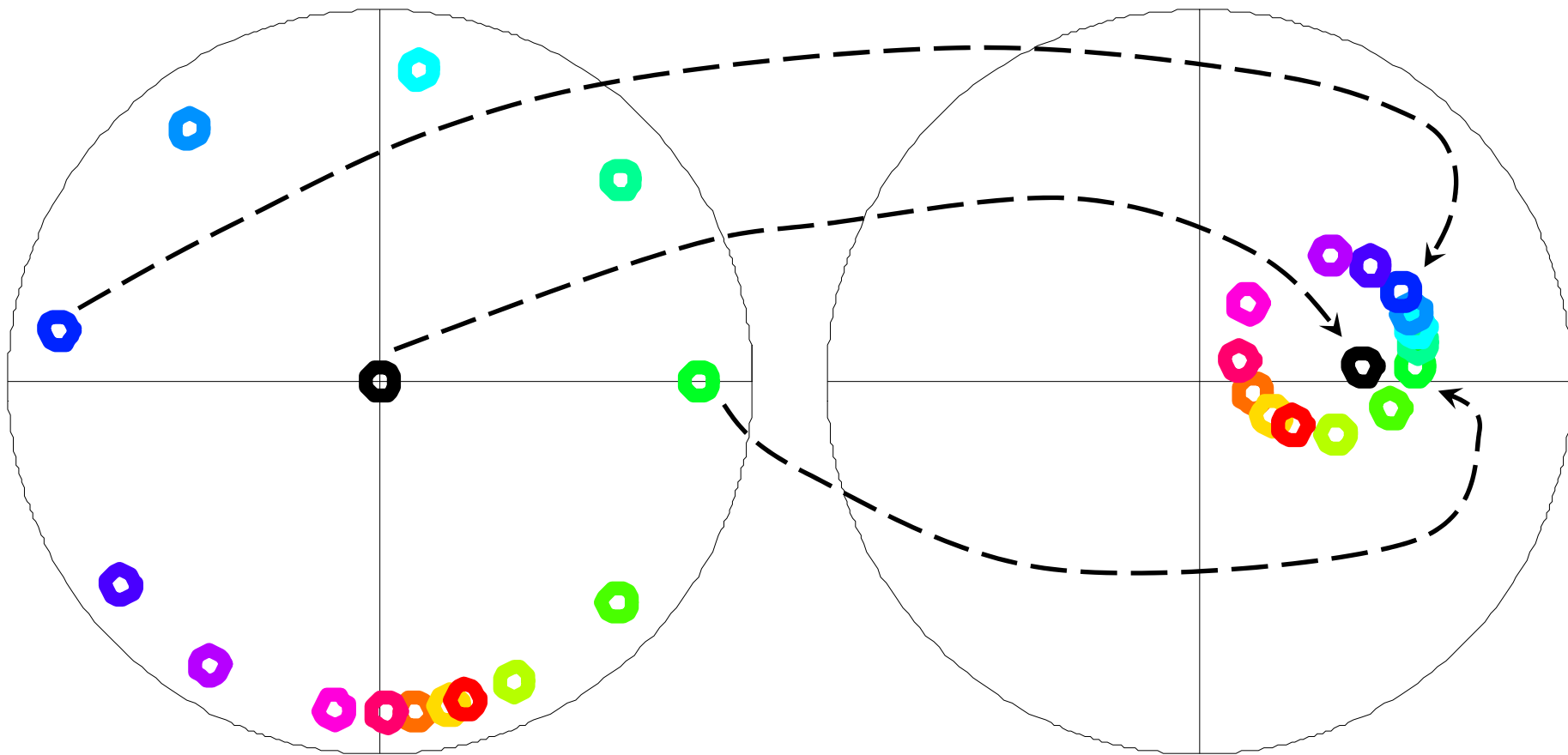
## ➤ Harmonic termination

- Impossible to implement with the existing setup
- Solution - branch off the signal between DUT and the load tuner, but:
  - load tuning range shrinks 😞
  - major mechanical re-design 😞
- Any other ideas?

# Calibration - Input Reflection Mapping

$\Gamma$  seen by the input probe

Ch2/Ch1 ratio measured by MTA



# Conclusions

- **Vector load pull measurements can provide valuable info. Demonstrated in this presentation:**
  - **Maximum output voltage contours**
  - **Phase distortion contours**
- **An elaborate calibration procedure was devised for the source pull**
- **Harmonic termination cannot be implemented in the existing setup**