

Building mmWave Applications? Learn About TriQuint's TQP15.

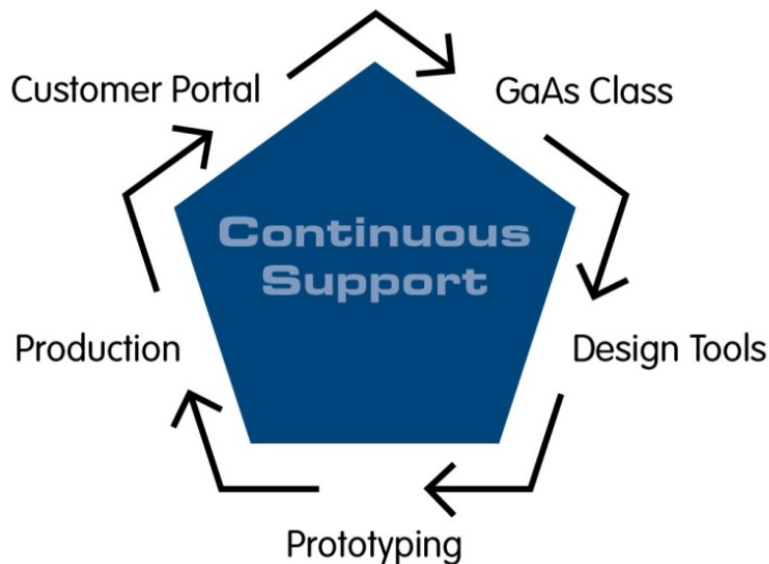
For CMP Annual User's Meeting
January 20, 2011

Connecting the Digital World to the Global Network®



Commercial Foundry Business Unit

- ◆ Leading GaAs foundry in the world
- ◆ Supplier for over 25 years
- ◆ Broadest range of GaAs and GaN foundry technologies
- ◆ Unmatched support and service



TQP15: Process Topology and Key Parameters

◆ Applications

- **Low Noise, Power Amplifiers**, VSAT, Pt-to-Pt, Converters, Ka-band PAs.

◆ Circuit elements

- Transistor (0.15 μ m D-mode pHEMT)
- D-S connected overlap Schottky diodes
- N- epitaxial and NiCr TFR resistors (120 and 50 ohms/sq)
- MIM capacitors (0.62 fF/ μ m²)
- Spiral inductors
- 2 layer gold interconnect
- BCB planarized global interconnect
- No airbridges
- Substrate vias

◆ Mask layers (w/o vias): 13

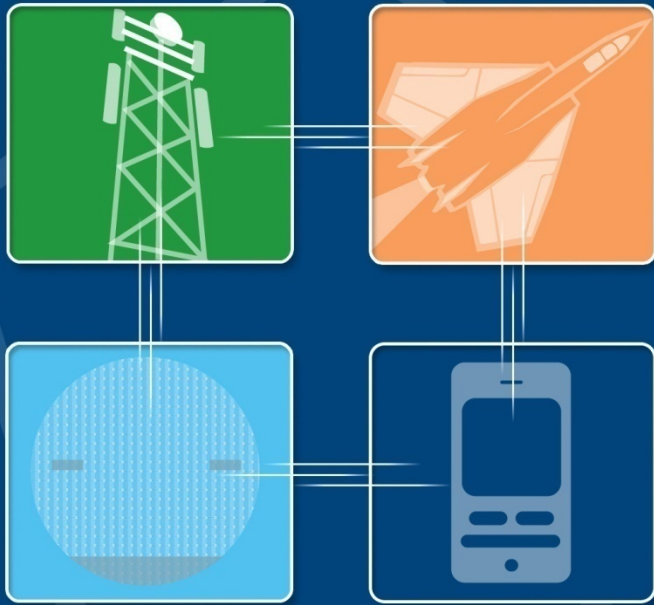
Parameter	TYP	Units
D Vp	-1.0	Volts
Idss	380	μ A/ μ m
I _{max}	580	μ A/ μ m
Gm (Idss/2)	550	mS/mm
Ft (peak)	80	GHz
Breakdown	14	Volts

DC Data @ Vds = 3.0V



TQP15 Released to Full Production

- ◆ Cost-effective mmWave
 - 6"/150mm wafers
 - I-line optical stepper
 - Spacer based optical lithography
- ◆ Mature and stable process
 - Leverage high volume modules in fab
 - Thousands of wafers run on spacer formed gates at TriQuint
 - Gate module qualified on two fully released flows
- ◆ Meets performance requirements
 - Ft enables Ka-band designs
 - Idss and Bv enable power density and operating voltages for a power market



TQP15 Performance and Design Tools

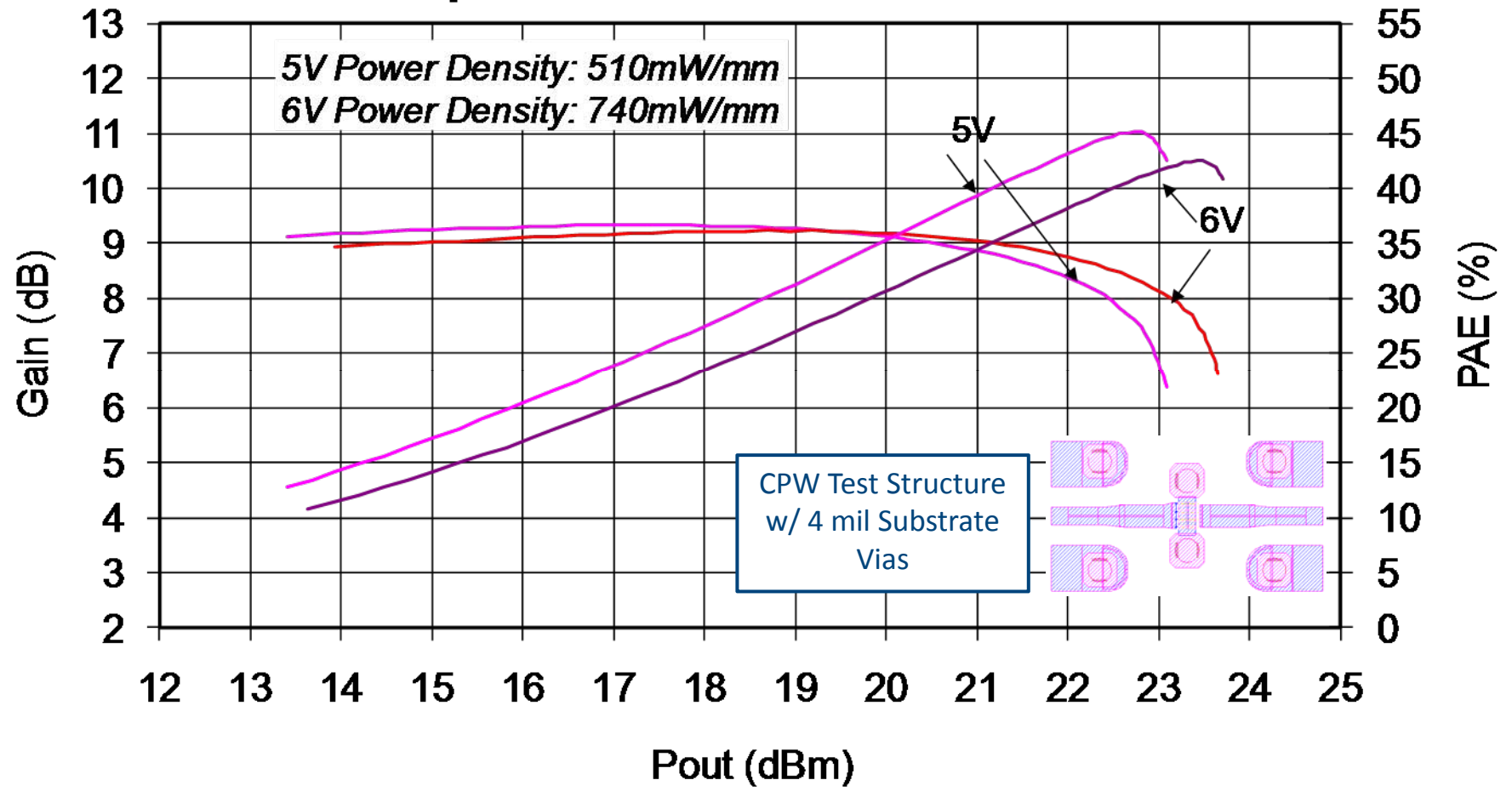
Connecting the Digital World to the Global Network®

TriQuint
SEMICONDUCTOR

25 YEARS OF
INNOVATION

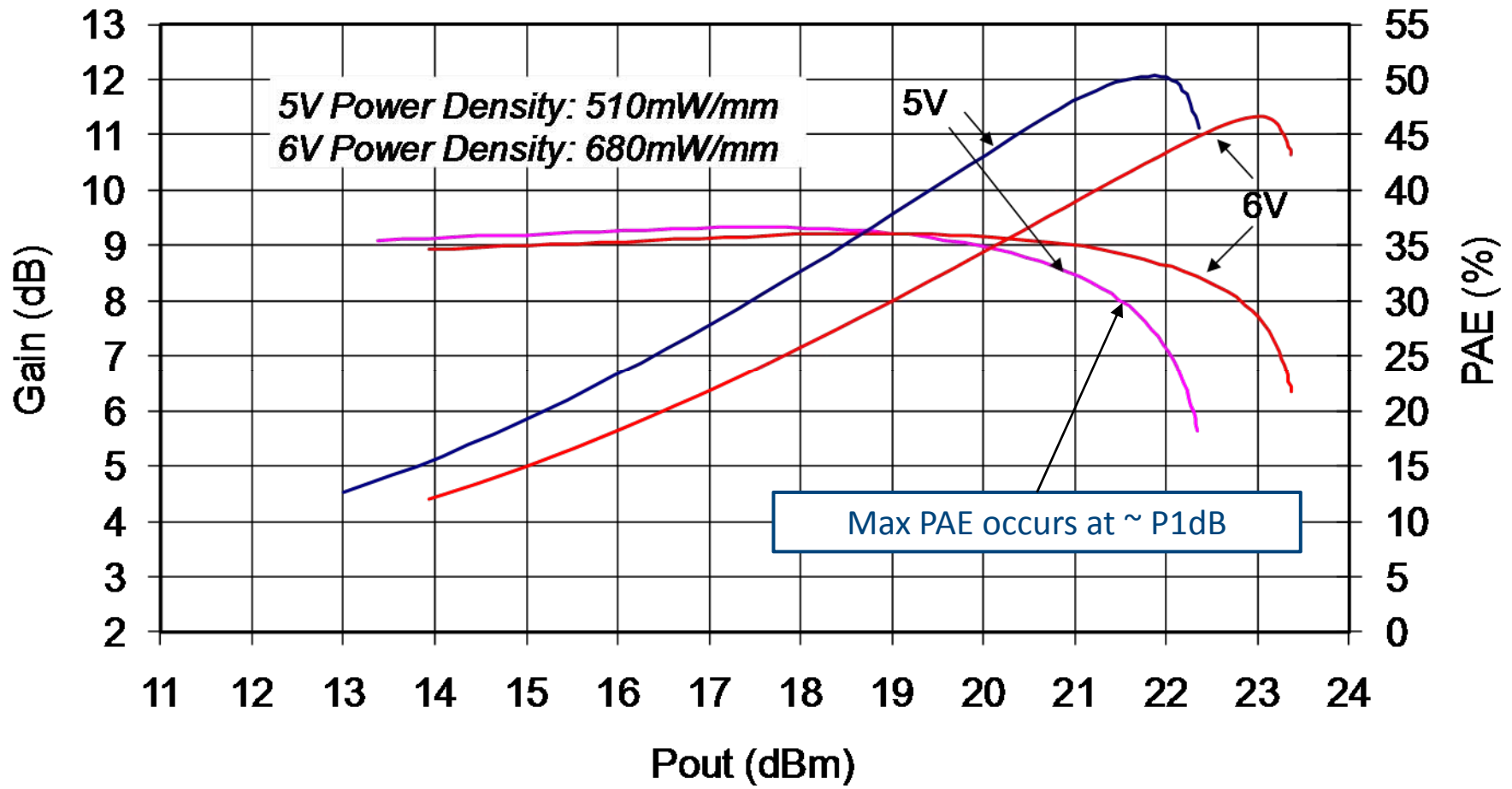
D4x50 SV: Max. Power Tune – 6V, 20mA

24GHz Loadpull: 4x75um Device Tuned for Po Max

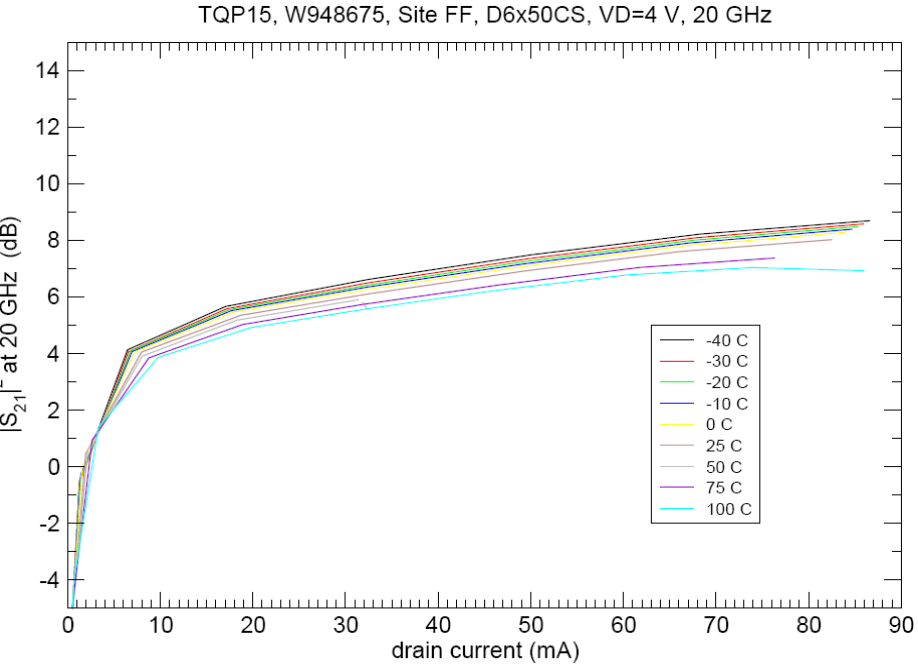
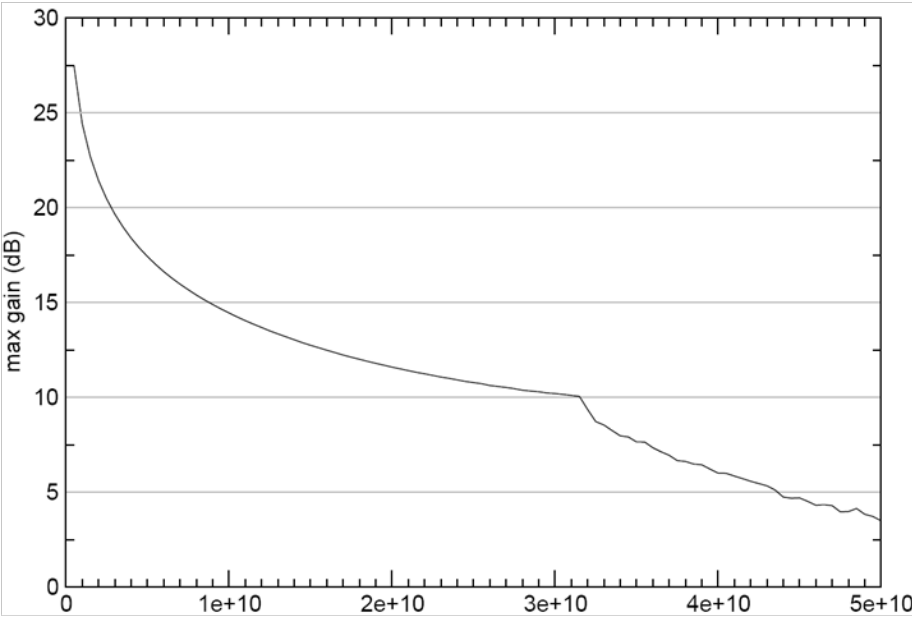


D4x50 SV: Max. PAE Tune – 6V, 20mA

24GHz Loadpull: 4x75um Device Tuned for Max PAE



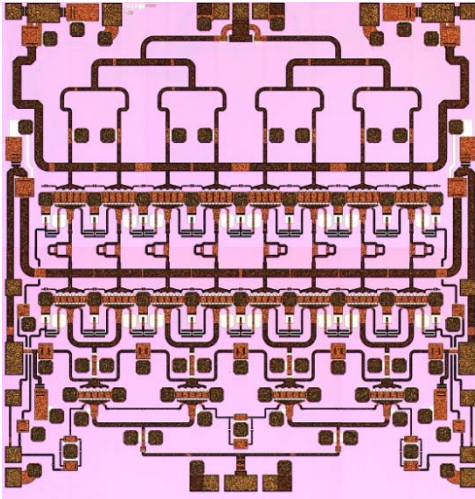
Small Signal Performance Over Frequency and Temperature



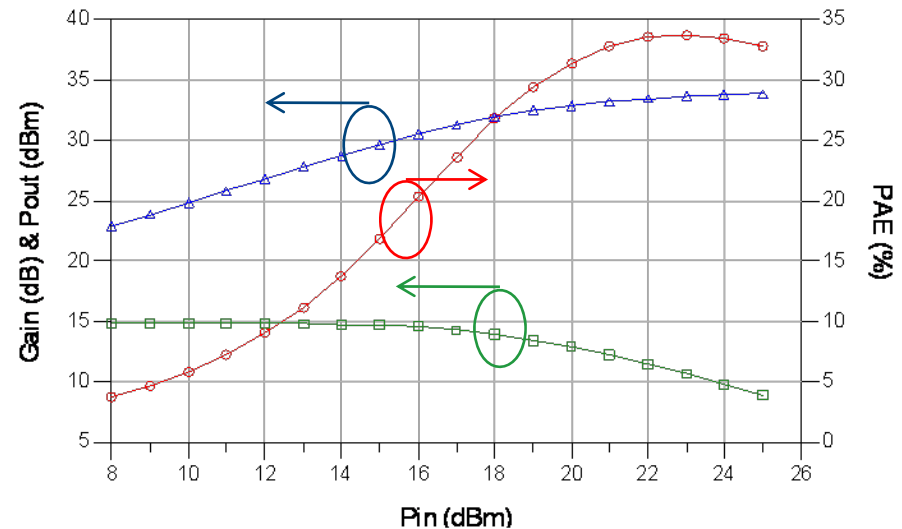
- ◆ MSG with 100 micron thickness substrate and substrate vias
- ◆ 10dB MSG at 30 GHz, usable gain up to 50 GHz
- ◆ Gain from -40°C to 100°C very well behaved

40 GHz PA Design Example

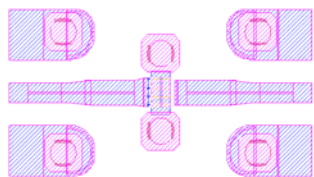
- ◆ 40 GHz power amplifier design goals
 - Push process limits for PA applications
 - >2 Watts Po
 - 15dB gain
 - Standard 100 micron substrate with vias



Simulation Results with TQS PDK



TQP15 Noise Figure and Associated Gain 2 to 26 GHz

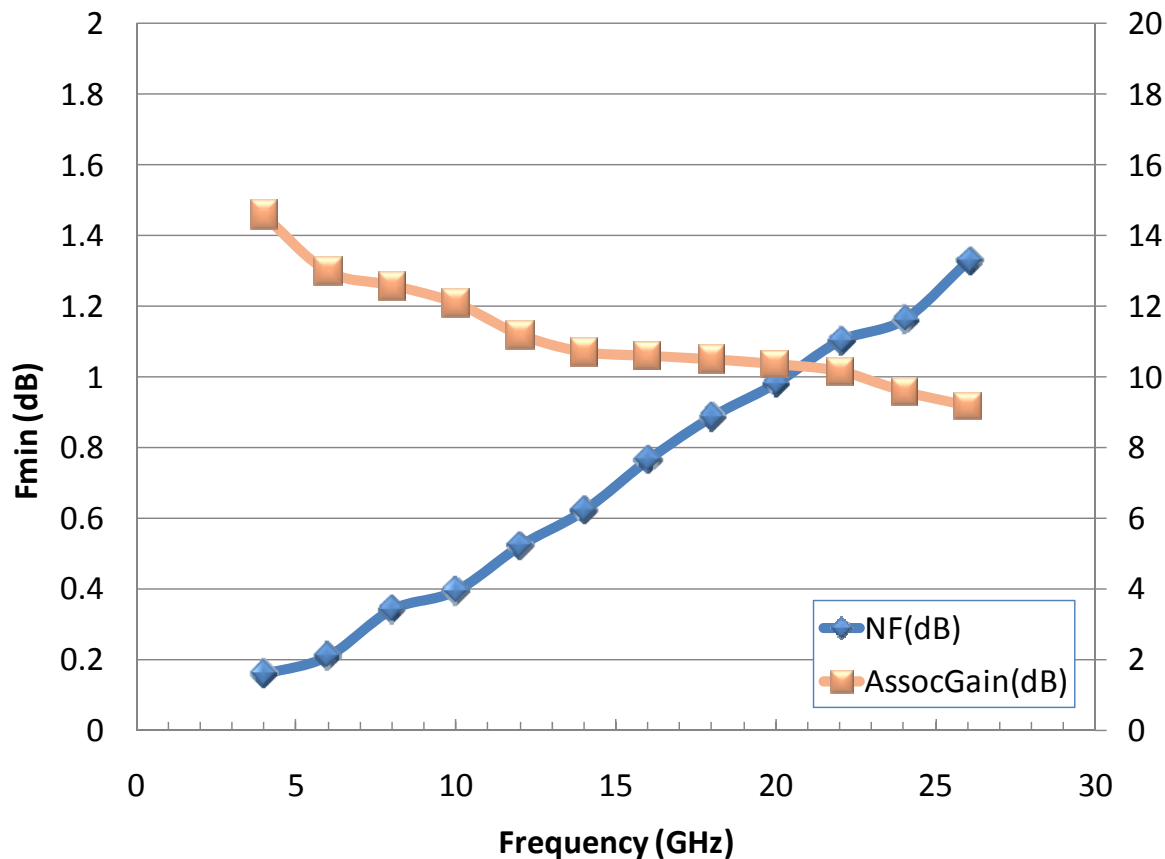


4x50µm CPW test structure w/ 100µm substrate vias



Thick gate metal results in low Fmin and low Rn, forgiving LNA matching

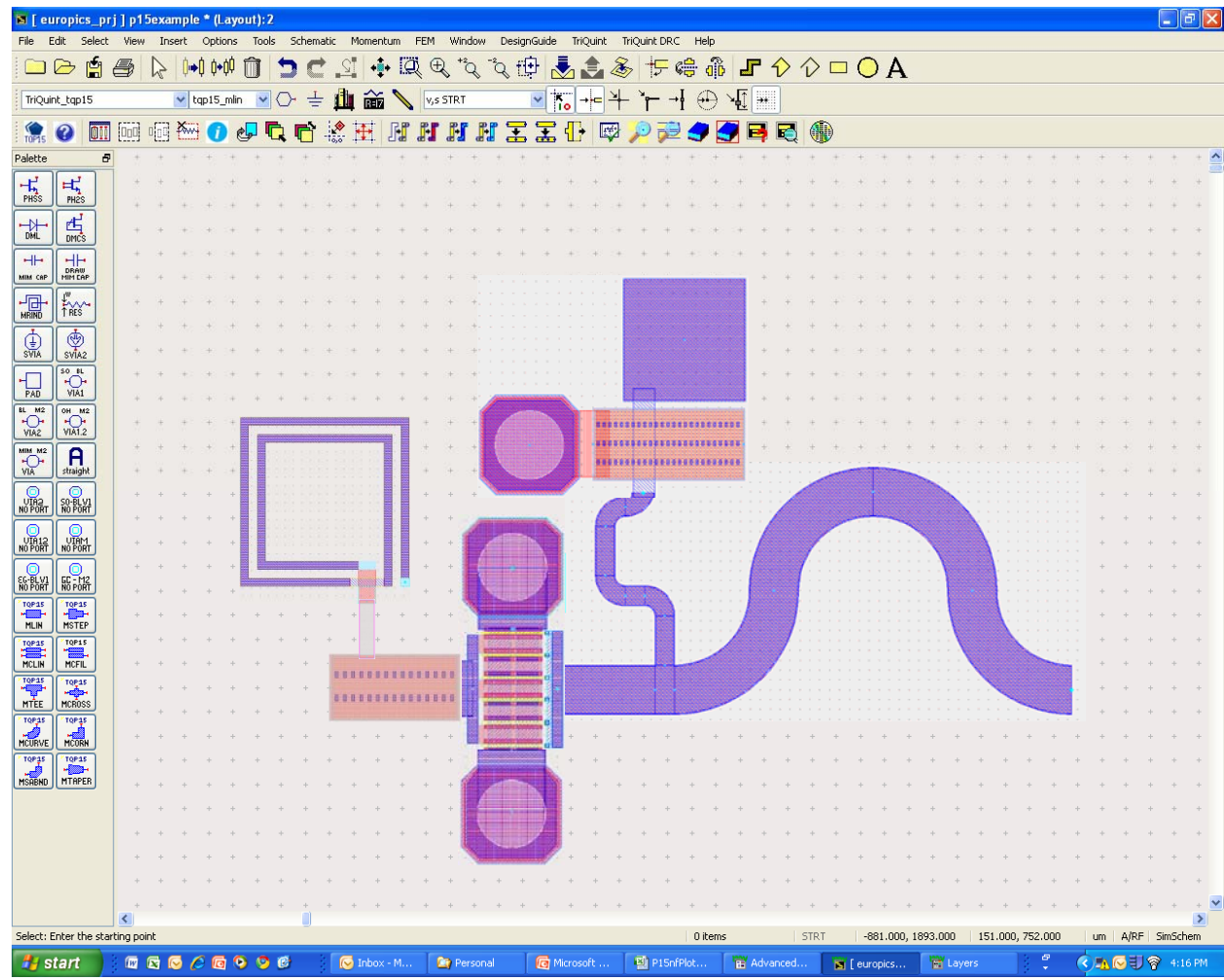
Vds=2V, Ids=20mA(25% Idss)



TQP15 Design Kit – by Agilent

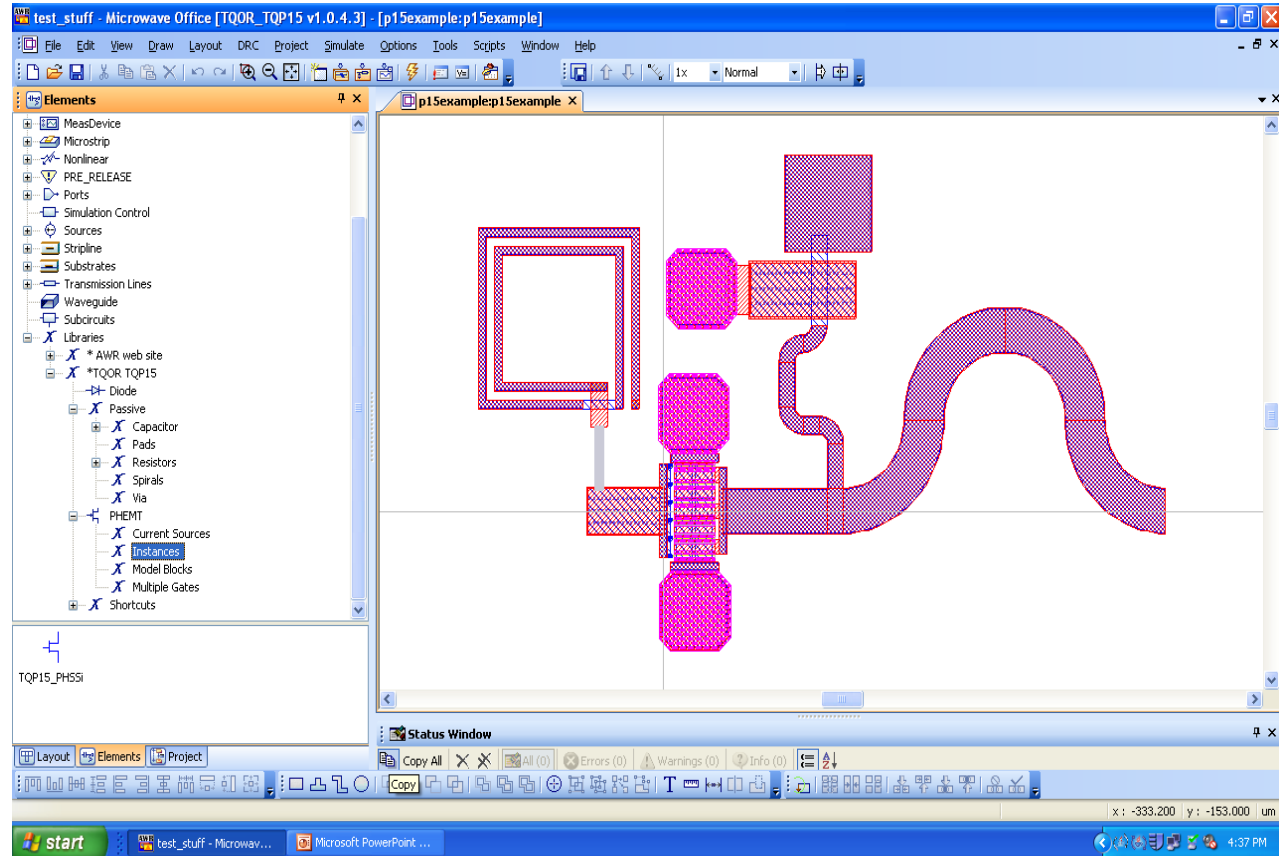
◆ The design kit supports active and passive components for accurate simulation and quick and easy layout

- FET cells
- Substrate vias
- Inductors
- Blocking caps
- Resistors
- Transmission line elements
- Bypass caps and bondpads

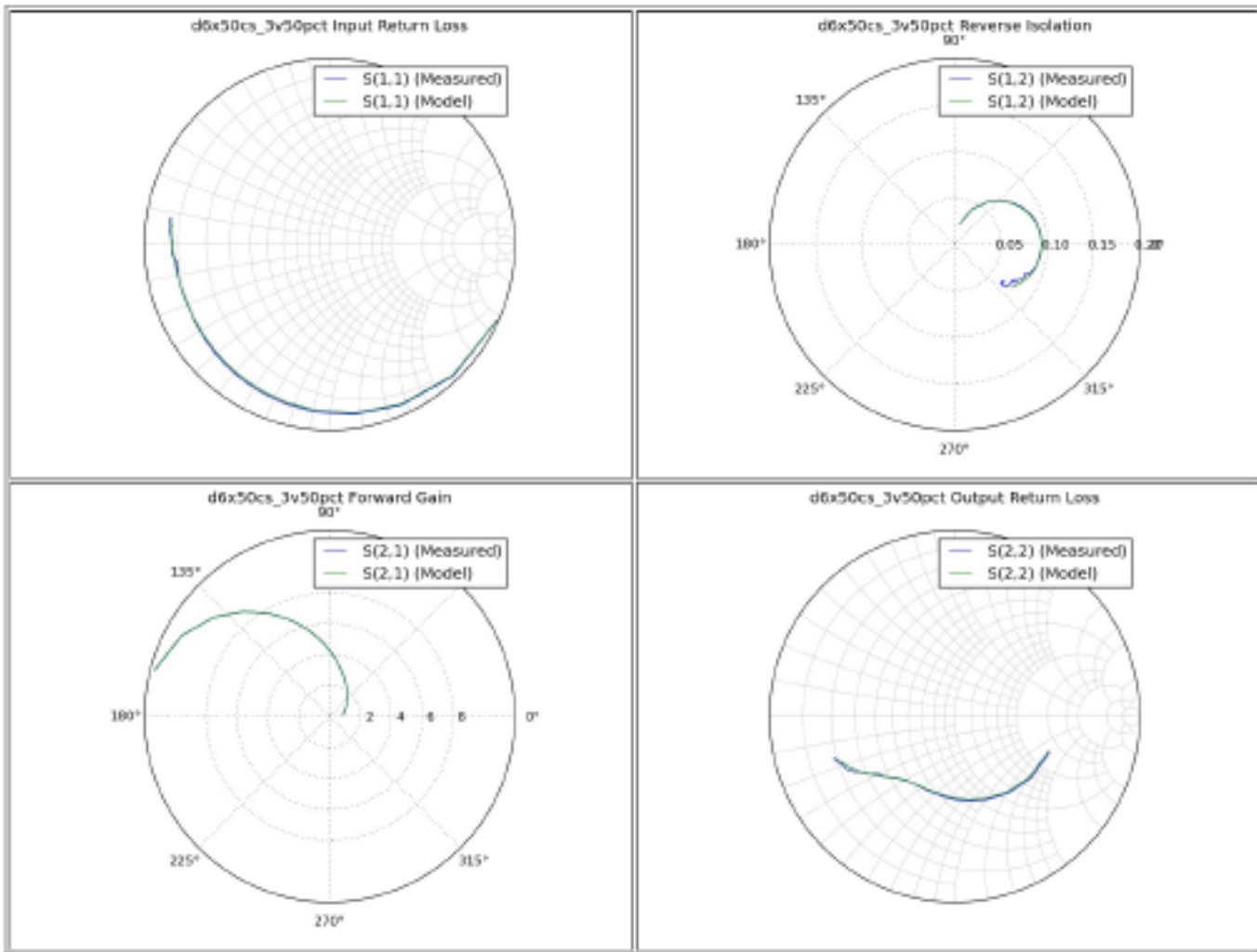


TQP15 Design Kit – by AWR

- ◆ The design kit supports active and passive components for accurate simulation and quick and easy layout
 - FET cells
 - Substrate vias
 - Inductors
 - Blocking caps
 - Resistors
 - Transmission line elements
 - Bypass caps and bondpads



TQP15 FET Simulation vs Measured S-Parameters



Commercializing mmWave Markets – Optical Gates

TQPED
0.5 μ m E/D

Ft = 27 GHz

Integrated WLAN,
Switches

TQP25
0.25 μ m D
0.35 μ m E

Ft = 55 GHz

Handset Switches,
LNAs, PtP,
Ku-band PAs

TQP15
0.15 μ m D

Ft = 80 GHz

VSAT, PtP,
Ka-band PAs

TQP13
0.13 μ m D

Ft = 100 GHz

Low Noise Amplifiers,
Auto Radar, WPAN,
Satellite, Imaging



- ◆ **Cost-effective mmWave process**
 - 6"/150mm wafers
 - I-line stepper
- ◆ **Mature & stable process**
 - Thousands of wafers run on spacer formed gates at TriQuint
- ◆ **Meets performance requirements**
 - $f_t > 80\text{GHz}$ enabling Ka band designs
 - World class power density and excellent noise figure.
- ◆ **Fully released process**
 - Design kits available now
 - Prototyping and samples available now
- ◆ **Design kits available now**
- ◆ **Ready to learn more? Contact**

