

0.15- μm 3MI Process Cross Section

General Description

The 0.15- μm Power pHEMT 3MI (3-metal-interconnect) process combines high power density and gain per stage performance. The process is optimized for high-power and low-noise operation through 80 GHz. Passives include 3 thick metal interconnect layers, precision TaN resistors, GaAs resistors, 3 MIM capacitor densities. Through-substrate vias and our cap-over-via process offer excellent grounds at higher frequencies. Our air bridges produce minimal interconnect capacitance and the 3MI's protective overcoat layer provides environmental robustness.

Features

- 0.15- μm amplifier transistors
- 0.15- μm switch transistors
- 0.15- μm , 2- μm and 4- μm diodes
- High Q passives
- 3 MIM capacitance densities
- TaN resistors
- GaAs resistors
- High-density interconnects
- 3 metal layers
- Air bridges
- Substrate vias
- Protective Overcoat
- Operation up to $V_d = 6\text{ V}$
- 550 mW/mm and 42% PAE @ 40 GHz
- 780 mW/mm and 52% PAE @ 30 GHz
- $NF_{\text{min}} = 1.3\text{ dB}$ and $G_{\text{ass}} = 8\text{ dB}$ @ 30 GHz

Applications

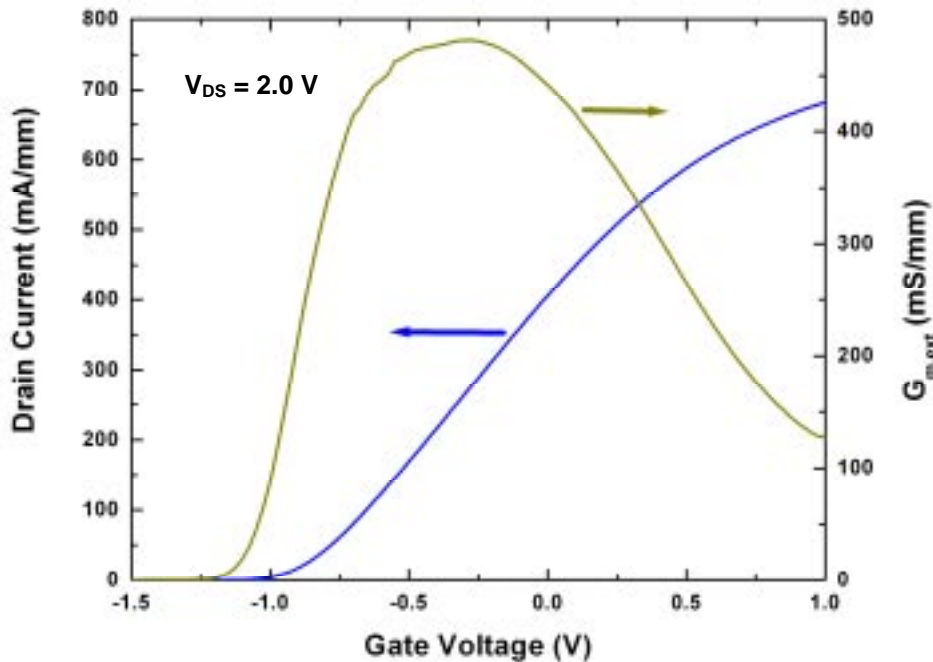
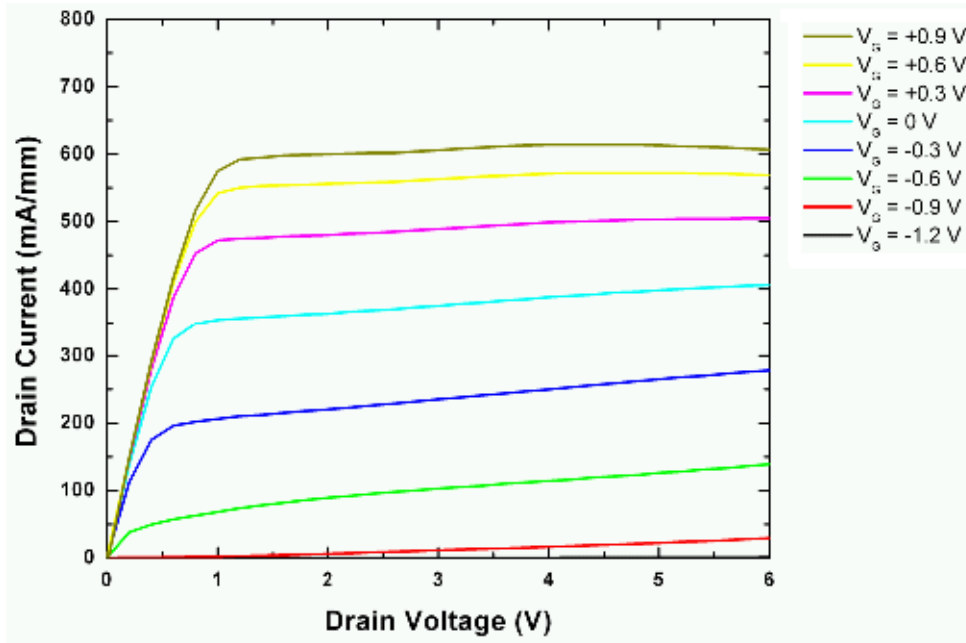
- Up to 80 GHz
- Communications
- Space
- Military
- Power amplifiers
- Driver amplifiers
- Low-noise amplifiers
- AGC amplifiers
- Limiting amplifiers
- Transimpedance amplifiers
- Differential amplifiers
- Digital and analog phase shifters
- Digital and analog attenuators
- Mixers (up and down converters)
- Switches
- Multipliers

** Unless otherwise noted; models and graphs in this process data sheet are for devices on a 100- μm thick substrate.*

0.15- μm Power pHEMT 3MI Process Details			
Element	Parameter	Typical Value	Units
FETs	I_{dss}	375	mA/mm
	G_{m}	450	mS/mm
	V_{bd}	-14	V
	V_{p}	-1.05	V
	F_{t} (peak)	100	GHz
MIM capacitors	density	240	pF/mm ²
		300	pF/mm ²
		1200	pF/mm ²
Capacitors over vias		yes	
TaN resistors	sheet resistance	50	Ohms/sq
GaAs resistors	sheet resistance	160	Ohms/sq
Vias		yes	
Substrate*	thickness	100, 50	μm

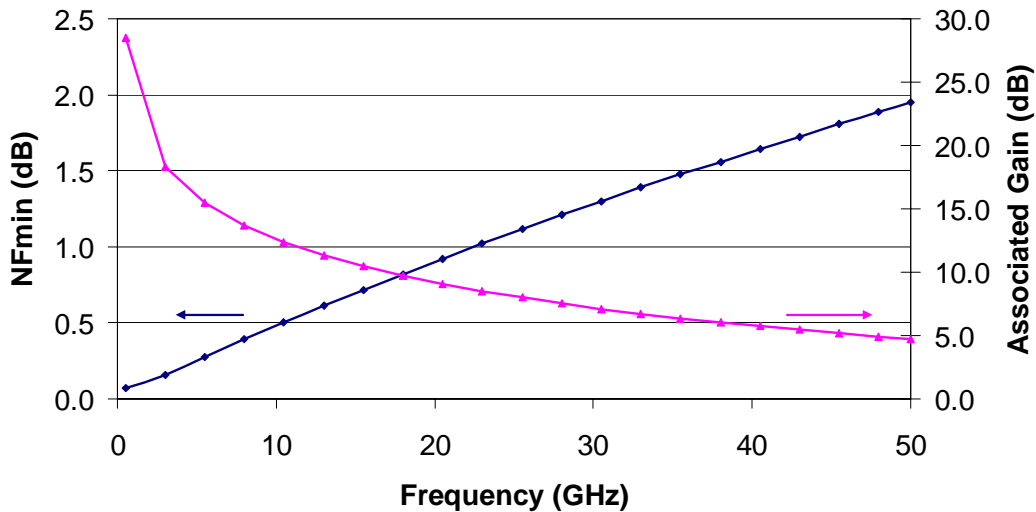
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0.15- μm Power pHEMT 3MI
DC Characteristics
100- μm FET

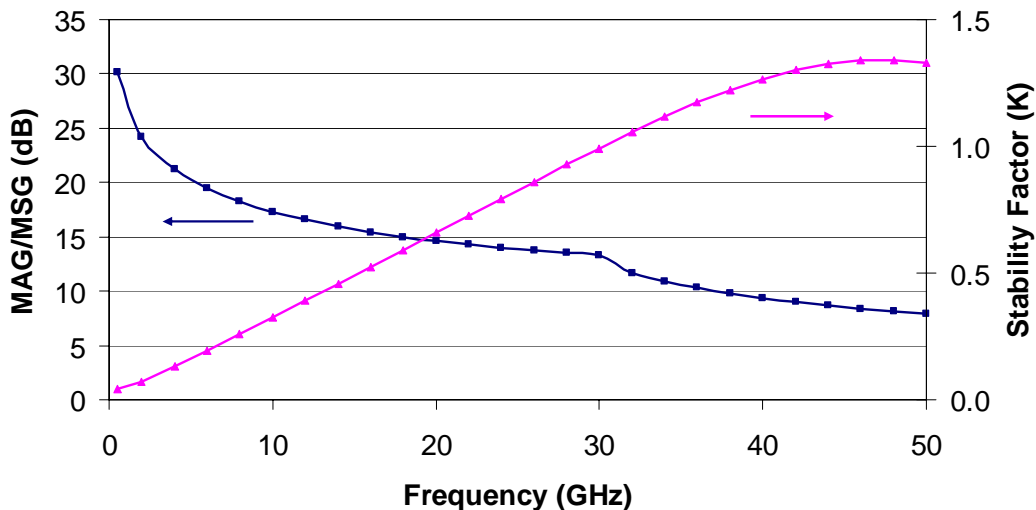


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0.15- μ m Power pHEMT 3MI
Minimum Noise Figure and Associated Gain
400 μ m FET @ 3 V, 30 mA

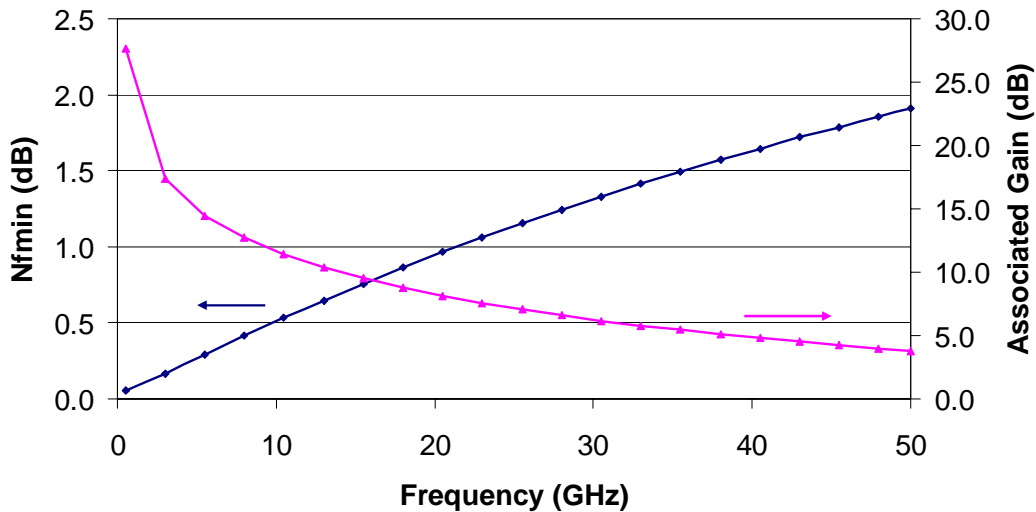


0.15- μ m Power pHEMT 3MI
Maximum Available/Stable Gain (MAG/MSG)
400 μ m FET @ 6 V, 60 mA

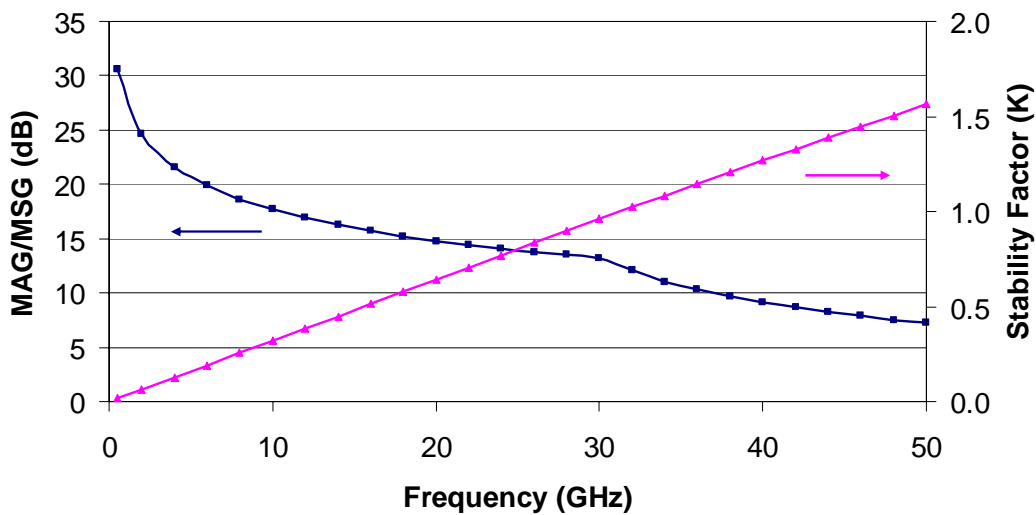


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0.15- μ m Power pHEMT 3MI on 50- μ m substrate
Minimum Noise Figure and Associated Gain
500 μ m FET @ 3 V, 37.5 mA

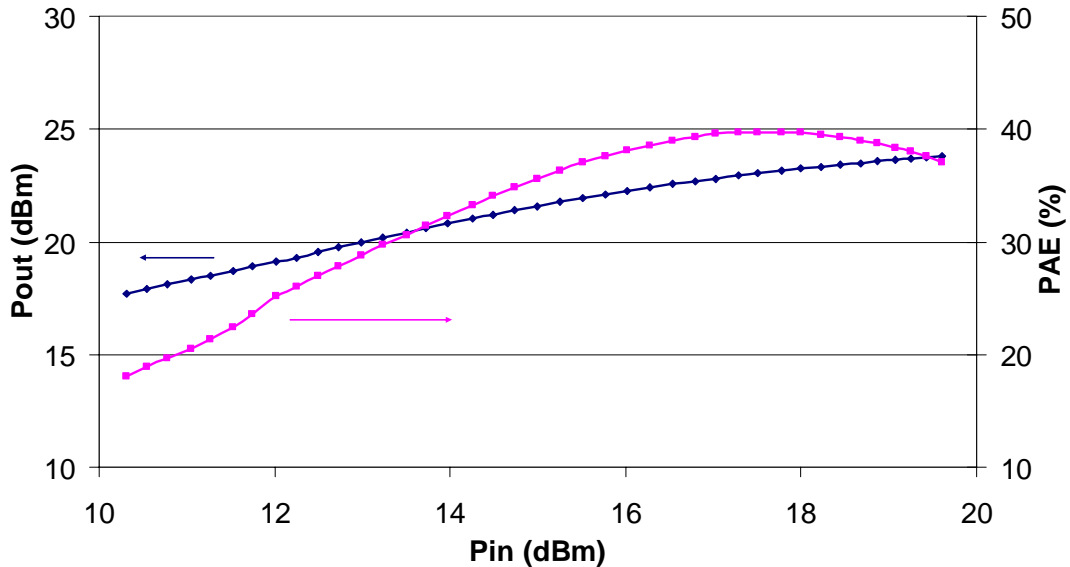


0.15- μ m Power pHEMT 3MI on 50- μ m substrate
Maximum Available/Stable Gain (MAG/MSG)
500 μ m FET @ 6 V, 75 mA

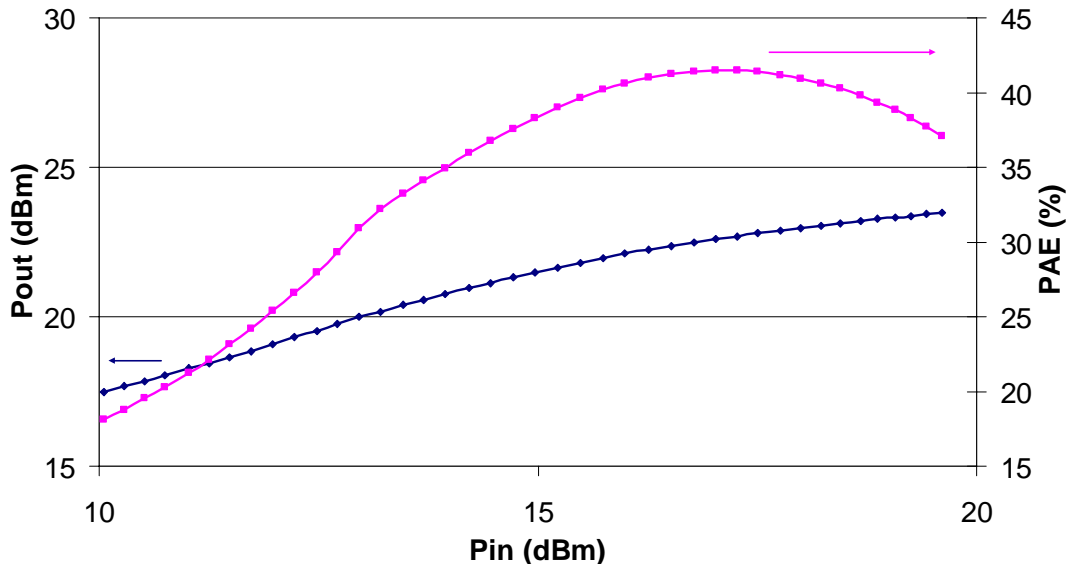


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0.15- μm Power pHEMT 3MI
Power Tuned Load
300 μm FET @ 6 V, 40 GHz



0.15- μm Power pHEMT 3MI
Efficiency Tuned Load
300 μm FET @ 6 V, 40 GHz



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FET Models Available		
Gate Pitch (μm)	Gate Fingers	FET Sizes (μm)
12 18	4	200
12 18	6	300
12 18	8	400
12 18	10	400, 800
20 20	6	300
20 20	8	400
20 20	10	600

Switch Models Available		
Gate Pitch (μm)	Gate Fingers	Switch Sizes (μm)
07 07	3	150, 225, 300
07 07	5	250, 375, 500
07 07	7	350, 525, 700
10 10	3	150, 225
10 10	5	250, 375, 500
10 10	7	250, 375, 1050

FET Models Available for 50- μm Substrate		
Gate Pitch (μm)	Gate Fingers	FET Sizes (μm)
10 10	4	200
10 10	6	300
20 33	4	300, 400
20 33	6	375, 600
20 33	8	500, 800
20 33	10	750

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Application Examples

32 - 47 GHz Wide Band Driver Amplifier TGA4521:

The TGA4521 is a compact driver amplifier for Ka-band and Q-band applications. It nominally provides 25 dBm saturated output power and 24 dBm output power at 1 dB gain compression at 38 GHz. It has a typical gain of 16 dB.

2W Q-Band High Power Amplifier TGA4046:

The TGA4046 is a compact high power amplifier for Q-band applications. It nominally provides 33 dBm of saturated output power and 32 dBm output power at 1 dB gain compression from 41 to 46 GHz. It provides 17 dB gain and 16 dB return loss.

Ka-Band 2W Power Amplifier TGA4516:

The TGA4516 is a high power amplifier for Ka-band applications. It provides > 33 dBm saturated output power and has a typical gain of 18 dB.

Ka-Band Power Amplifier TGA4517:

The TGA4517-EPU is a 50-micron thick, high power amplifier for Ka-band applications. It provides a nominal saturated output power of 35 dBm. Typical gain is 15 dB with a nominal return loss of 12 dB.

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Prototyping and Development

- Prototype Chip Option (PCO)
 - Shared mask set
 - Run often
 - Backside via process included
 - PCM (process control monitor) qualified wafers
 - For PCO schedules (100- μ m thick substrate only), please visit http://www.triquint.com/prodserv/divisions/foundry/new/proto_sched_pco.cfm
- Prototype Wafer Option (PWO)
 - Customer-specific masks
 - Customer schedule
 - 2 wafers delivered
 - Backside vias included
 - PCM (process control monitor) qualified wafers

Design Tools

- Device libraries of circuit elements:
 - FETs
 - Thin-film and implanted resistors
 - Capacitors
 - Inductors
- Agilent ADS design kit
- MASC Library
- Models for the 100- μ m thick substrate available for use in AWR Microwave Office

Training

- GaAs design classes:
 - Half-day introduction upon request
 - 3 day technical training upon request at the TriQuint Texas facility

Process Status

- 0.15- μ m Power pHEMT 3MI is fully released and qualified
- Contact TriQuint or visit <http://www.triquint.com/company/quality/> for more information on quality and reliability.

Applications Services

- Tiling of GDSII stream files including PCM (process control monitor)
- Design rule checking
- Layout versus schematic checking
- Engineering:
 - On-wafer DC test
 - On-wafer RF test
 - Thermal analysis
 - Yield enhancement
- Part qualification
- Failure analysis

Manufacturing Services

- Mask making
- Wafer thinning
- Wafer dicing
- Substrate vias
- DC die sort testing
- RF on-wafer testing
- Final visual testing

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