TowerJazz High Performance SiGe BiCMOS processes

The Global Specialty Foundry Leader

Total 8″ Equivalent Capacity of ≈ 1.7M WPY

Seoul, Korea
Sales and Support Office

Nishiwaki, Japan
8″ Fab

700K WPY

Santa Clara, CA, USA
Sales and Support Office

Austin, TX, USA
Sales Office

Munich
Sales Office

UK & France
Sales Reps

Netanya, Israel
Worldwide Design Center

Tokyo, Japan
Sales Reps

Virginia, USA
Sales Office

Shanghai, China
Sales and Support Office

Newport Beach, CA, USA
8″ Fab

290K WPY

Brazil
Sales Office

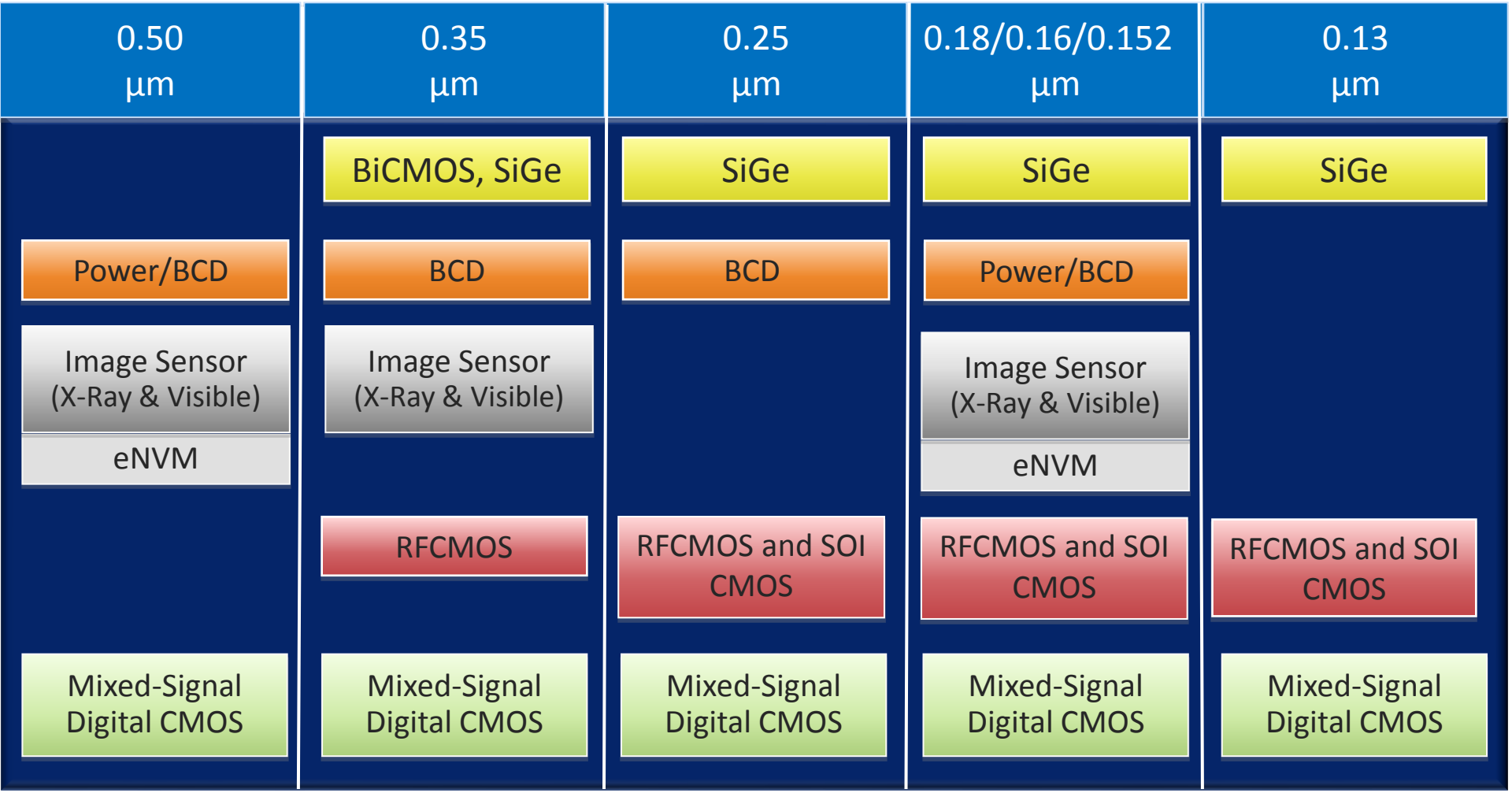
Migdal Haemek, Israel
8″ Fab and 6″ Fab

720K WPY

Hsinchu, Taiwan
Sales Office

Bangalore, India
Sales Office

Comprehensive Technology Portfolio



RF and HPA Applications and Technology

RF and Tuners

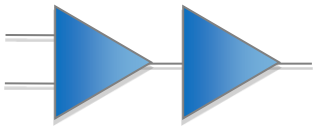
RF CMOS and SiGe BiCMOS

- Cell Phone, WiFi TxRx
- Basestation, Specialty Wireless
- TV, Satellite, STB Tuners

Front-End Modules

SOI Switch and SiGe Power Amplifiers

- Power Amplifiers
- Antenna Switch
- PA Controllers



mmWave

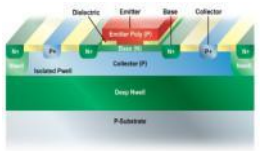
High Performance SiGe

- Optical Fiber Networks
- Automotive Radar
- 60 GHz WiFi, 24GHz Backhaul
- Light Peak and Thunderbolt
- GPS LNA

High Performance Analog

Complementary BiCMOS

- Line Drivers DSL, HomePlug, ATE
- HDD PreAmp
- DAC, ADC



Best-in-class SiGe, RF CMOS, RF models and Design Enablement

4

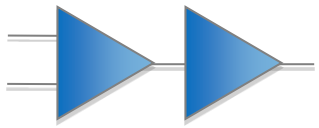
Front-End Module Technology

Controller

RF CMOS Controller Platform

- 5V, 0.18um optimized CMOS
- Up to 50% die size shrink vs. 0.25um
- 1.8V Logic, Bipolar, LDMOS options

SOI Switch



Platform for integration of FEM

- Thin-Film SOI (best in class Ron-Coff)
- Thick-Film SOI for ease of integration
- 5V control, LNA, PA/Driver options

Power Amplifier

SiGe PA, through-silicon-via (TSV), IPD

- SiGe PA cells for WiFi and Cellular
- TSV for low-inductance ground
- 1.8/3.3/5V CMOS, high res options
- IPD (5um dual-Cu in development)

Design Services and IP

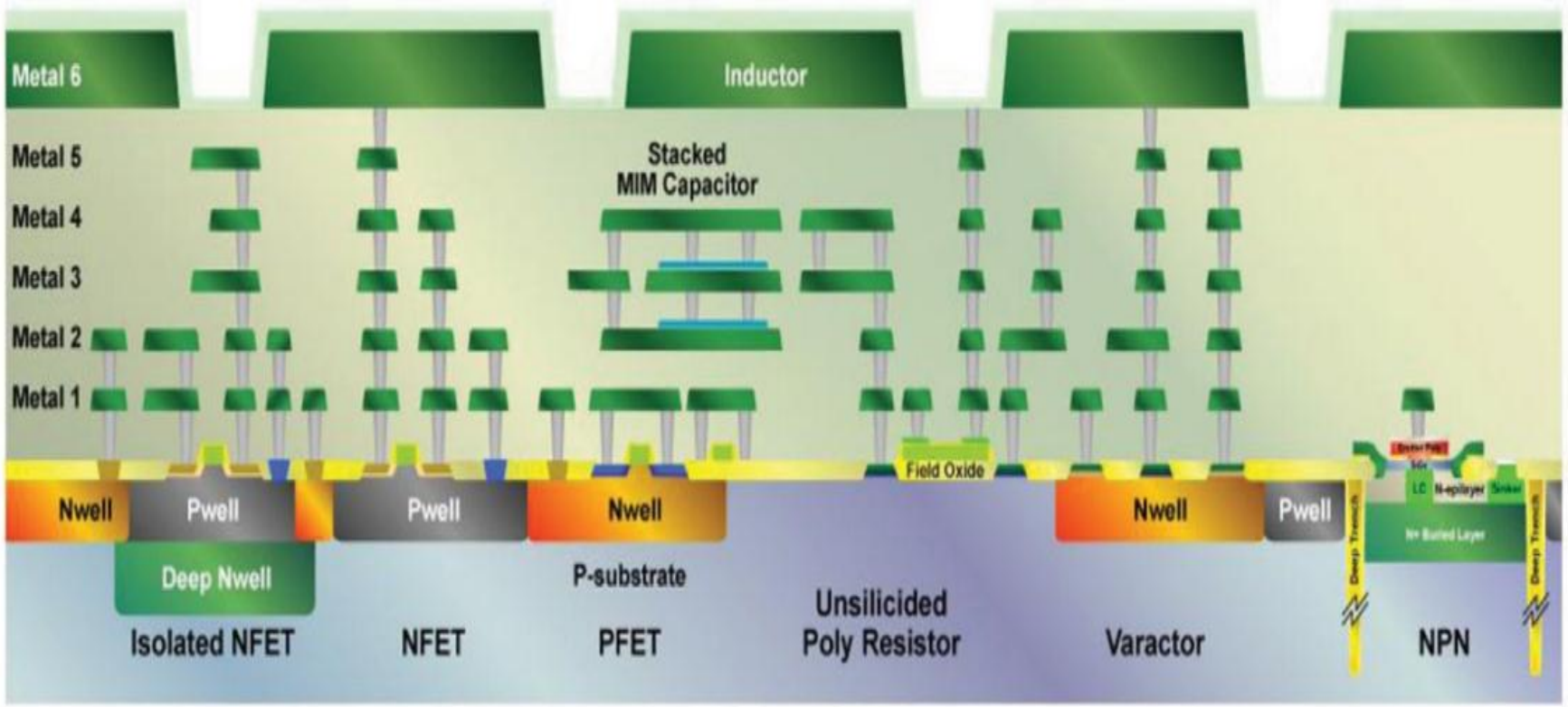
Models, design tools and IP

- Example: PA Design Library (PADL)
- Example: 4T, 6T, 9T SOI Switch IP
- Analog / RF Design Services

Best-in-class SiGe, RF CMOS, RF models and Design Enablement

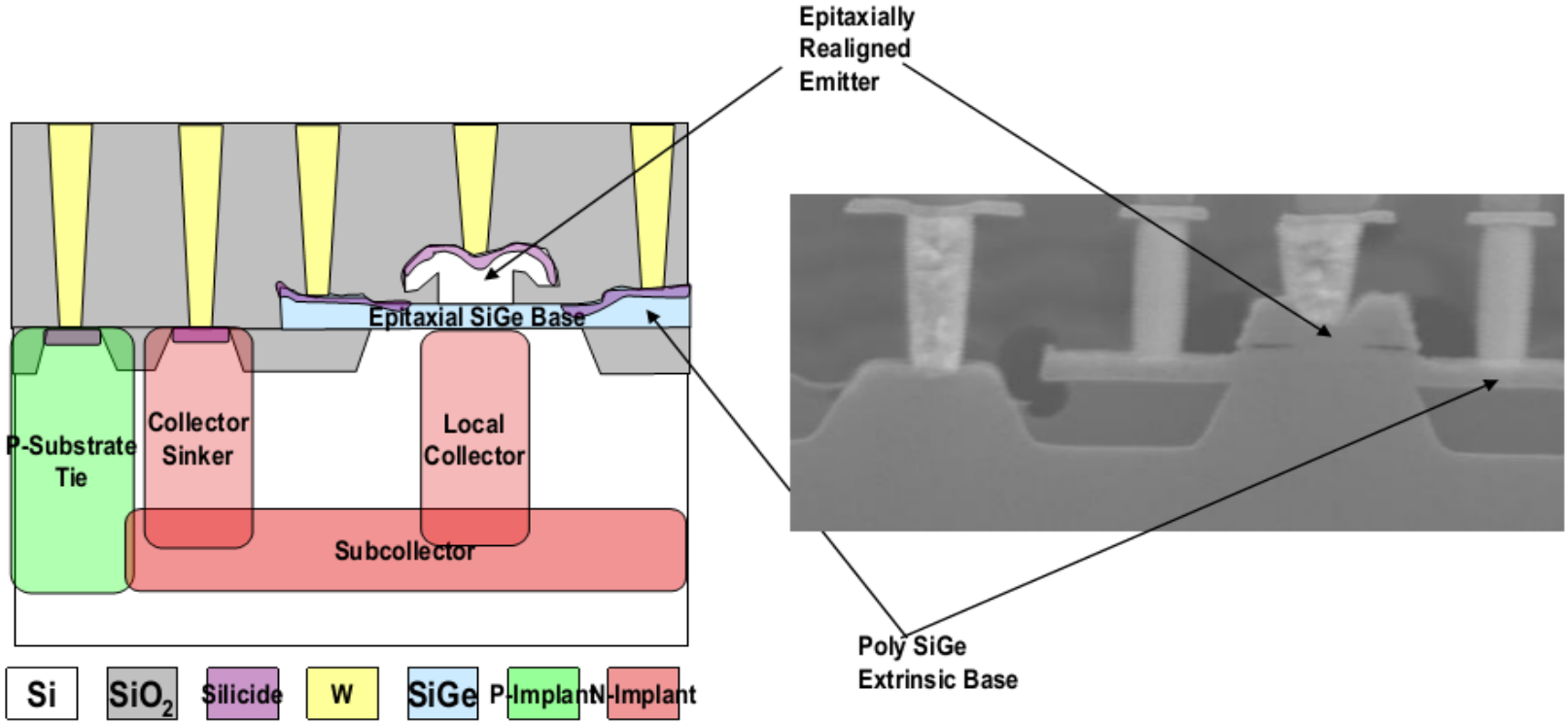
5

Schematic of Key Features in SiGe BiCMOS platform



- The SiGe HBJTs are embedded into complimentary BiCMOS platforms offering high performance RF , analog and digital performances.

SiGe HBJT device structure



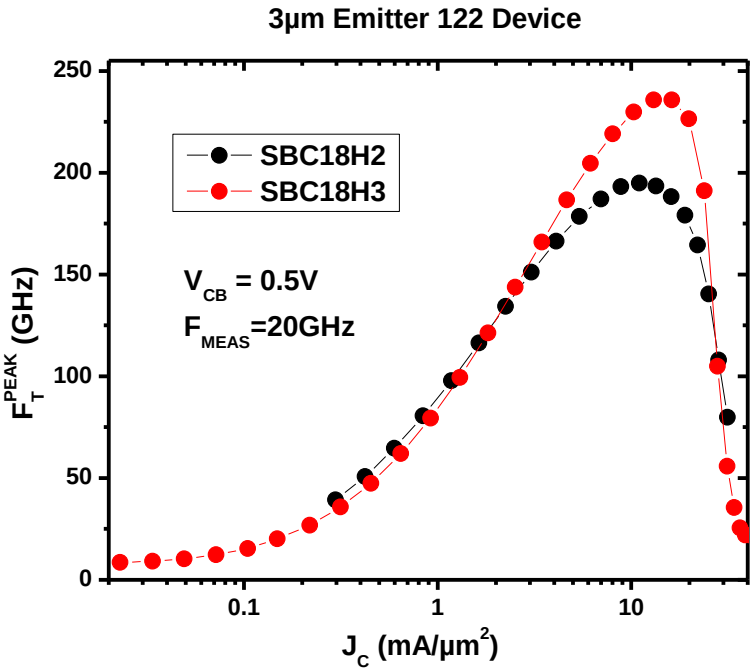
- The high-performance bipolar transistors are built “vertically” meaning that the n-p-n structure is created perpendicularly from the top of the wafer down.

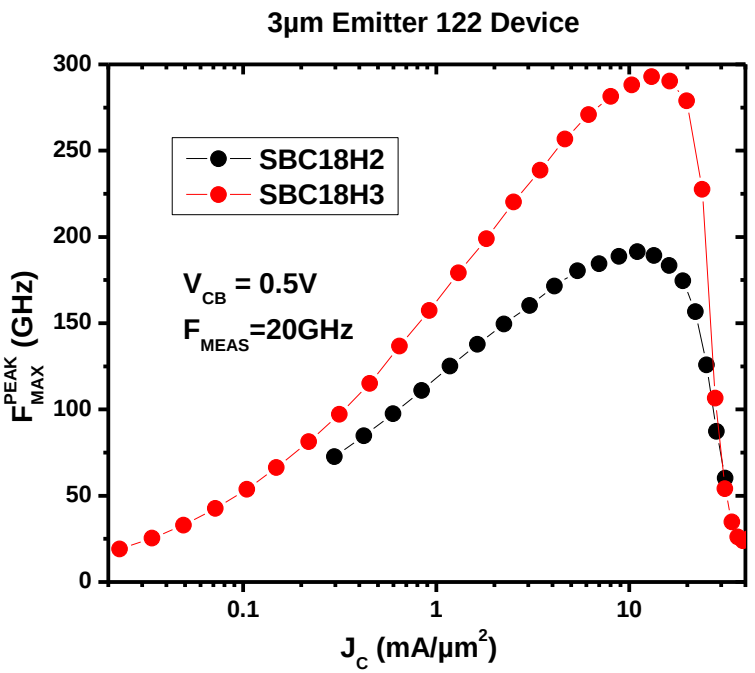
TowerJazz High Speed SiGe Processes

		SBC18HA	SBC18H2	SBC18H3	SBC13HA	SBC13H3
Status		Prod.	Prod.	Proto.	Proto.	Devel.
CMOS	Voltages	1.8/3.3V	1.8/3.3V	1.8/3.3V	1.2/3.3V	1.2/3.3V
HS Bipolar	F_T (GHz)	150	200	240	200	240
	F_{MAX} (GHz)	190	200	270	200	270
	BV_{CEO} (V)	2.2	1.9	1.6	1.9	1.6
Capacitor	fF/µm^2	2.8/5.6	2/4	2.8/5.6	2.8/5.6	2.8/5.6
Varactor	Q at 20 GHz	10	NA	15	NA	15
LPNP	Beta	32	7	30	7	30

- There are numerous other SBC18 flavors in production with variations in back end configuration, selection of available devices etc.
- Presented data mainly from the SBC18H2/H3 flavors.

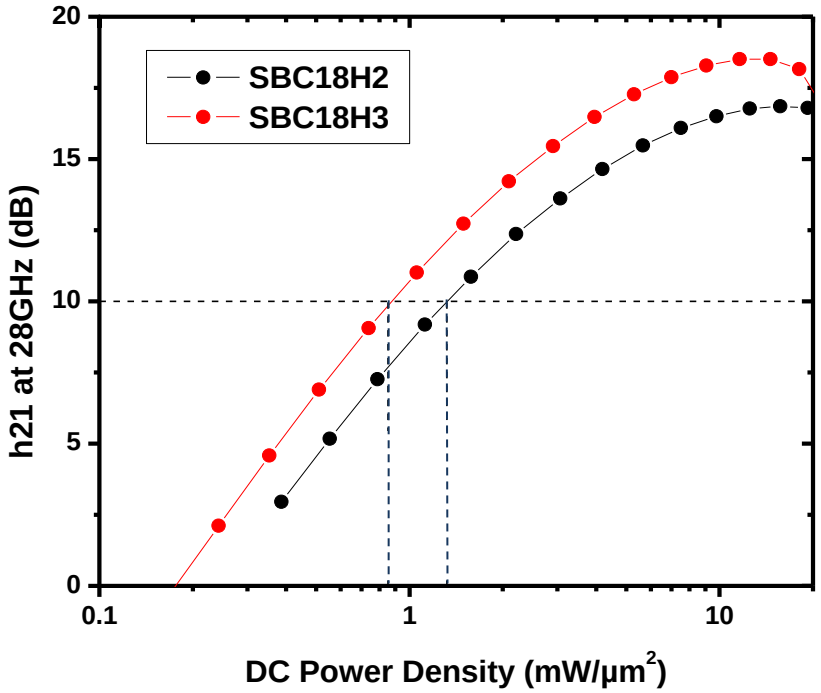
SiGe HBJT's current and power gain

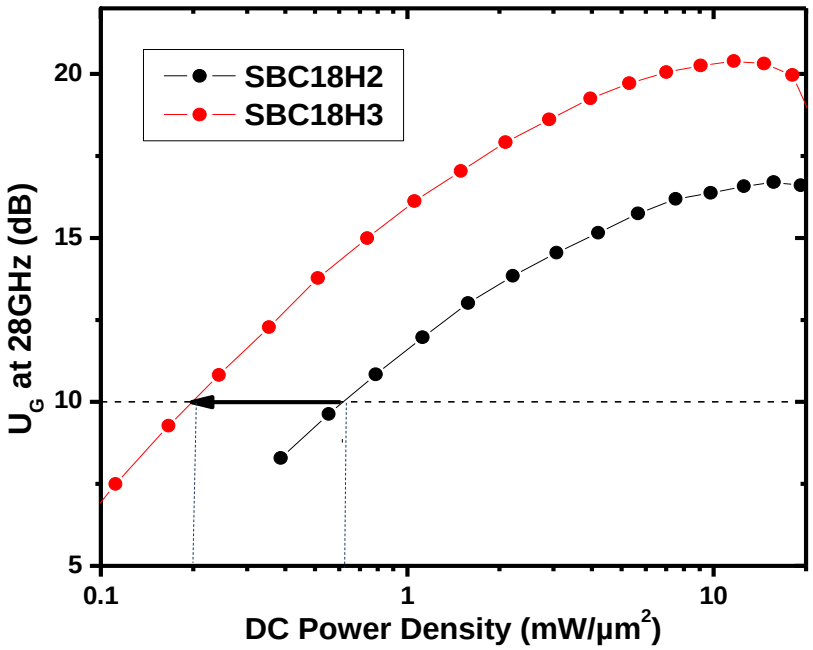




- 240 GHz Ft / 270 GHz Fmax devices in mass production.
- High frequency performances sustained for wide collector current range.

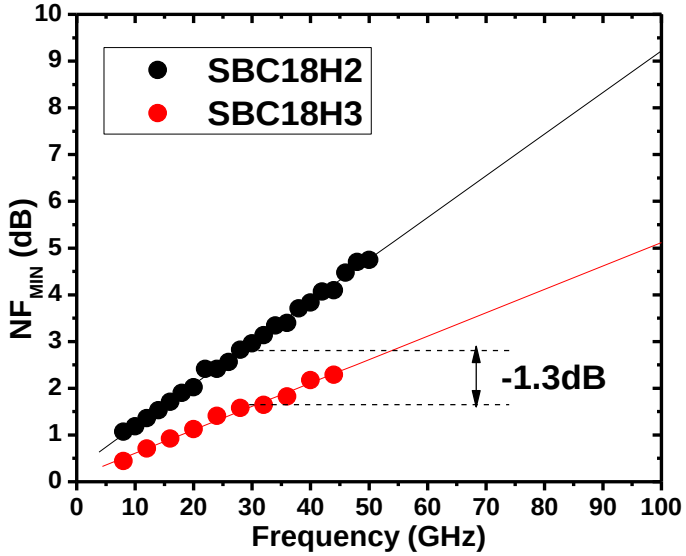
SiGe HBJT's gain vs DC power density

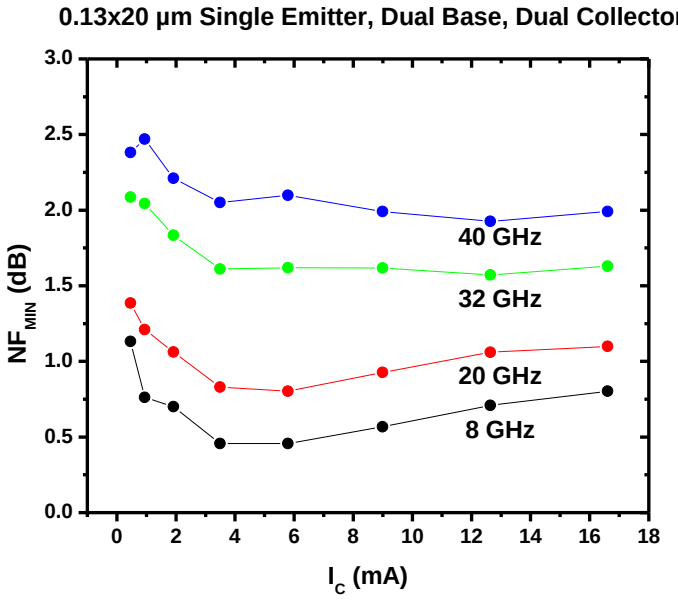




- TowerJazz Devices are optimized for low power consumption.

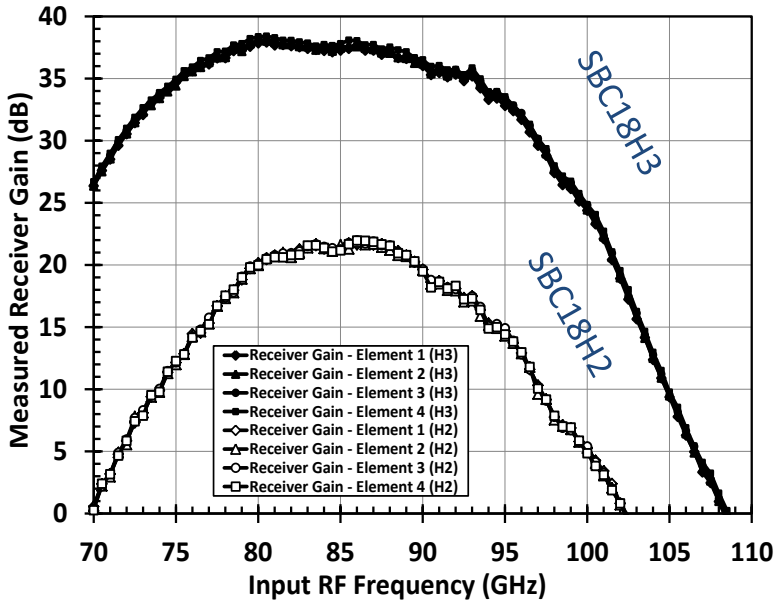
SiGe HBJT's Noise

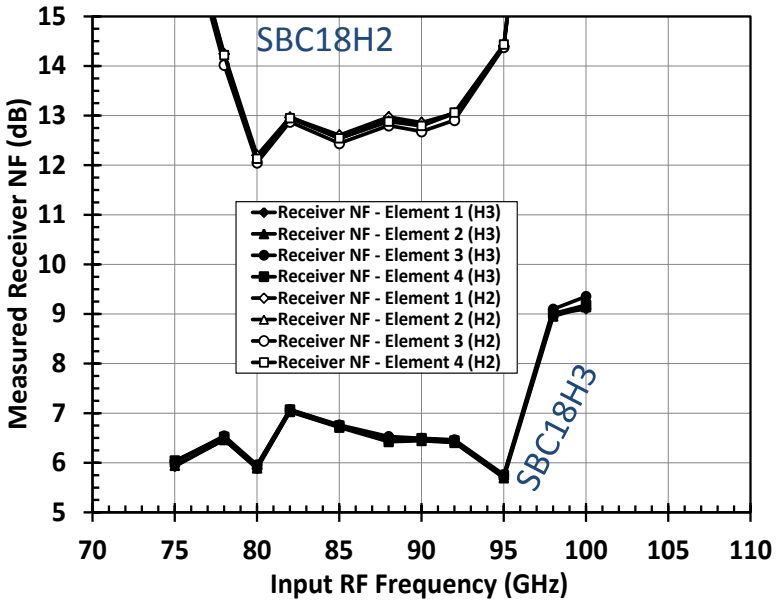




- SBC18H4 minimum noise figure at 20Ghz is measured less than 1dB and at 40GHz at only 2dB.
- NFMIN is flat across various frequency ranges.

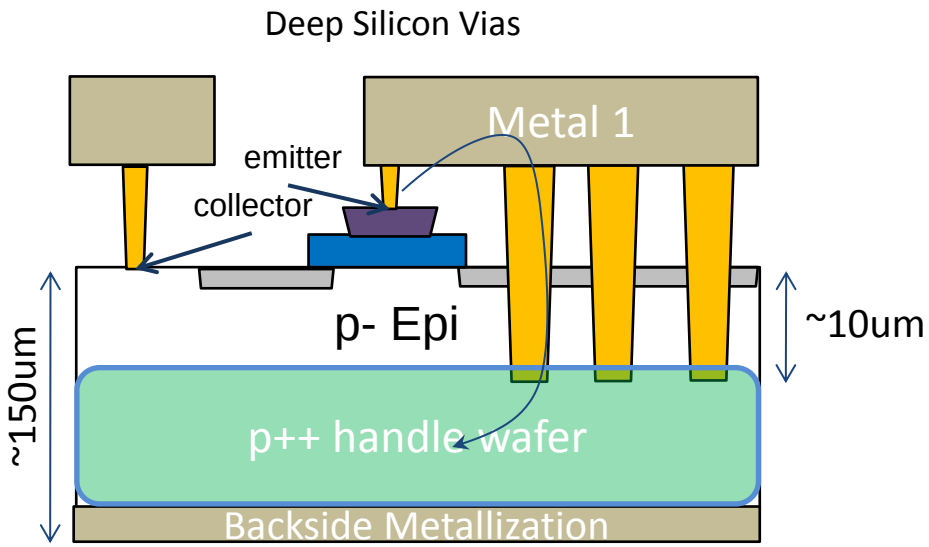
Circuit examples at ~100GHz: LNAs

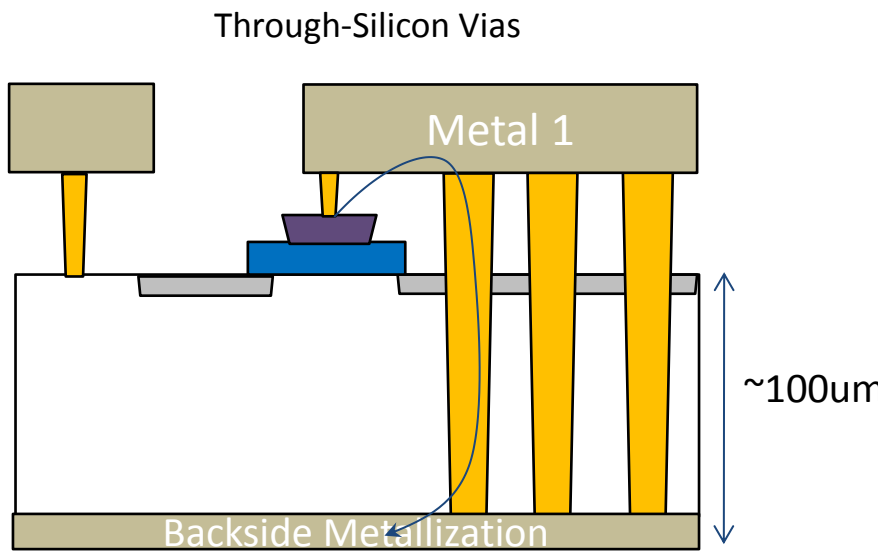




- Broad band mm-wave LNAs fabricated in SBC18H2 and SBC18H3
- 4 identical LNAs built for a 4-channel W-band phased-array receiver
- Nearly 30dB of gain above noise floor at 85GHz
- Almost perfect matching between LNAs

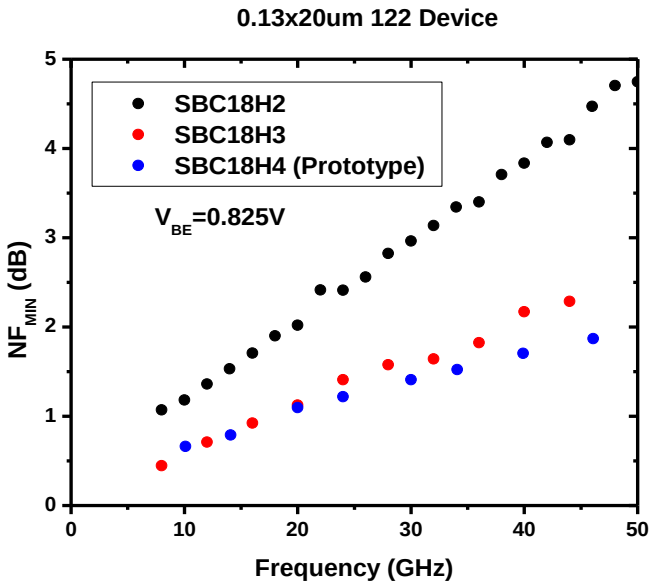
RF Grounding:
Deep Silicon Vias vs. Through Silicon Vias

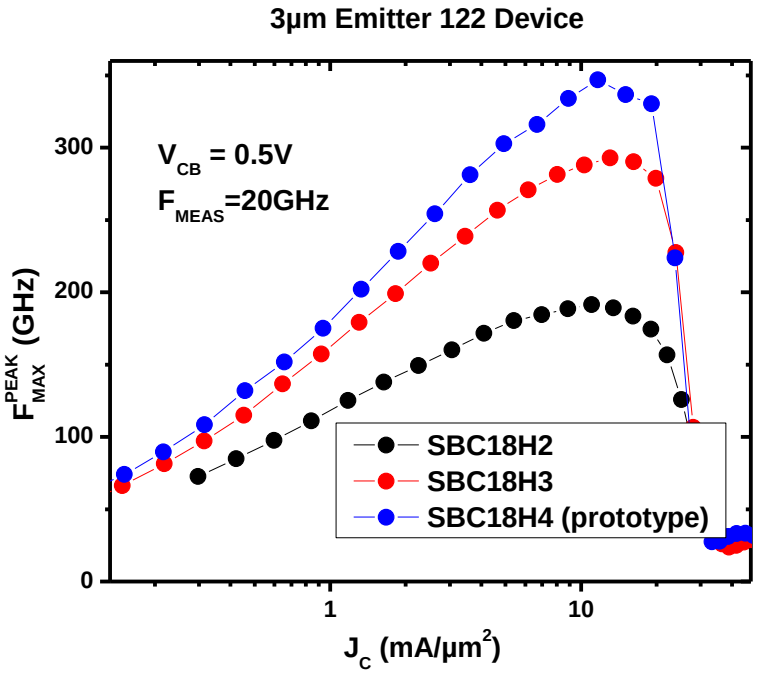




- Deep Silicon Vias and Through Silicon Vias are available for enhanced RF grounding.

Bipolar Roadmap





- next generation (SBC18H4) is in final development stage ,Fmax=350Ghz , improved noise figure.
- SiGe NPN on thick film SOI under development.

Summary

- TowerJazz offer SiGe HBJT devices on 0.35µm, 0.18µm and 0.13µm technology nodes.
- TowerJazz SiGe HBJT offers Best in class SiGe Speed / Power and Best in class Noise.
- The SiGe HBJTs are embedded into complimentary BiCMOS platforms offering high performance RF, analog and digital performances.

www.towerjazz.com

Complete SBC18H3 Device Roster

Family	Device	Characteristics
CMOS	1.8V CMOS	Model-exact copy of all other TJ 0.18um CMOS
	3.3V CMOS	
Bipolar	HS NPN	240 GHz F_T / 280 GHz F_{MAX}
	STD NPN	55GHz F_T / 3.2V BV_{CEO}
	LPNP	β=35
Resistors	Poly	235 Ω/sq and 1000 Ω/sq
	Metal	25 Ω/sq TiN on M3
Capacitors	Single MIM	2 or 2.8 fF/μm^2
	Stacked MIM	4 or 5.6 fF/μm^2
Varactors	1.8V MOS	Q @ 20GHz = 20
	Hyper-abrupt junction	Q @ 20GHz =15, Tuning Ratio = 21%
RF Diodes	p-i-n	Isolation <-15dB, Insertion loss > -3.5dB at 50GHz
	Schottky	F_C > 800 GHz

SiGe HBJT basic layout-122 configuration