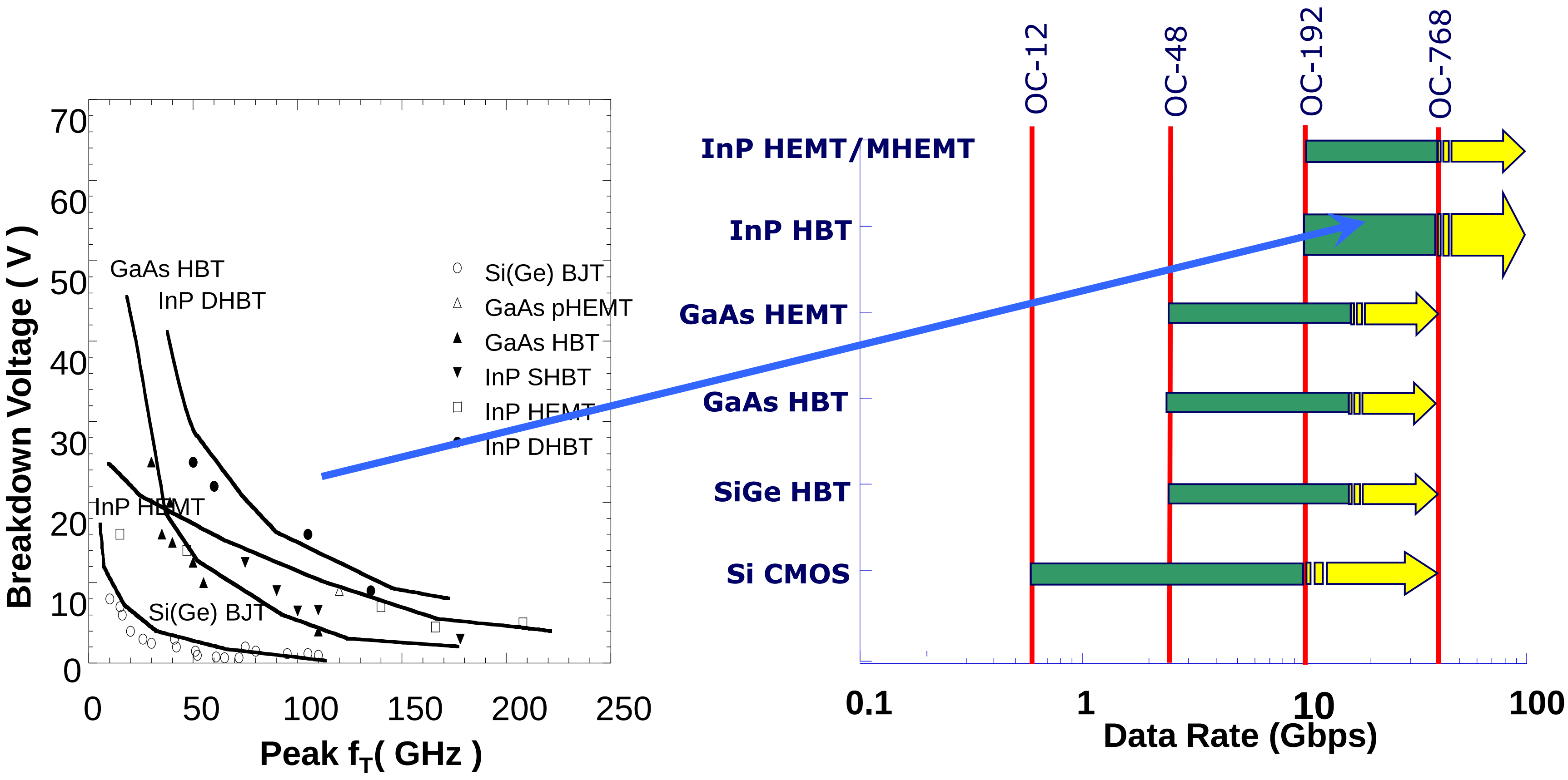
InP HBT Technology

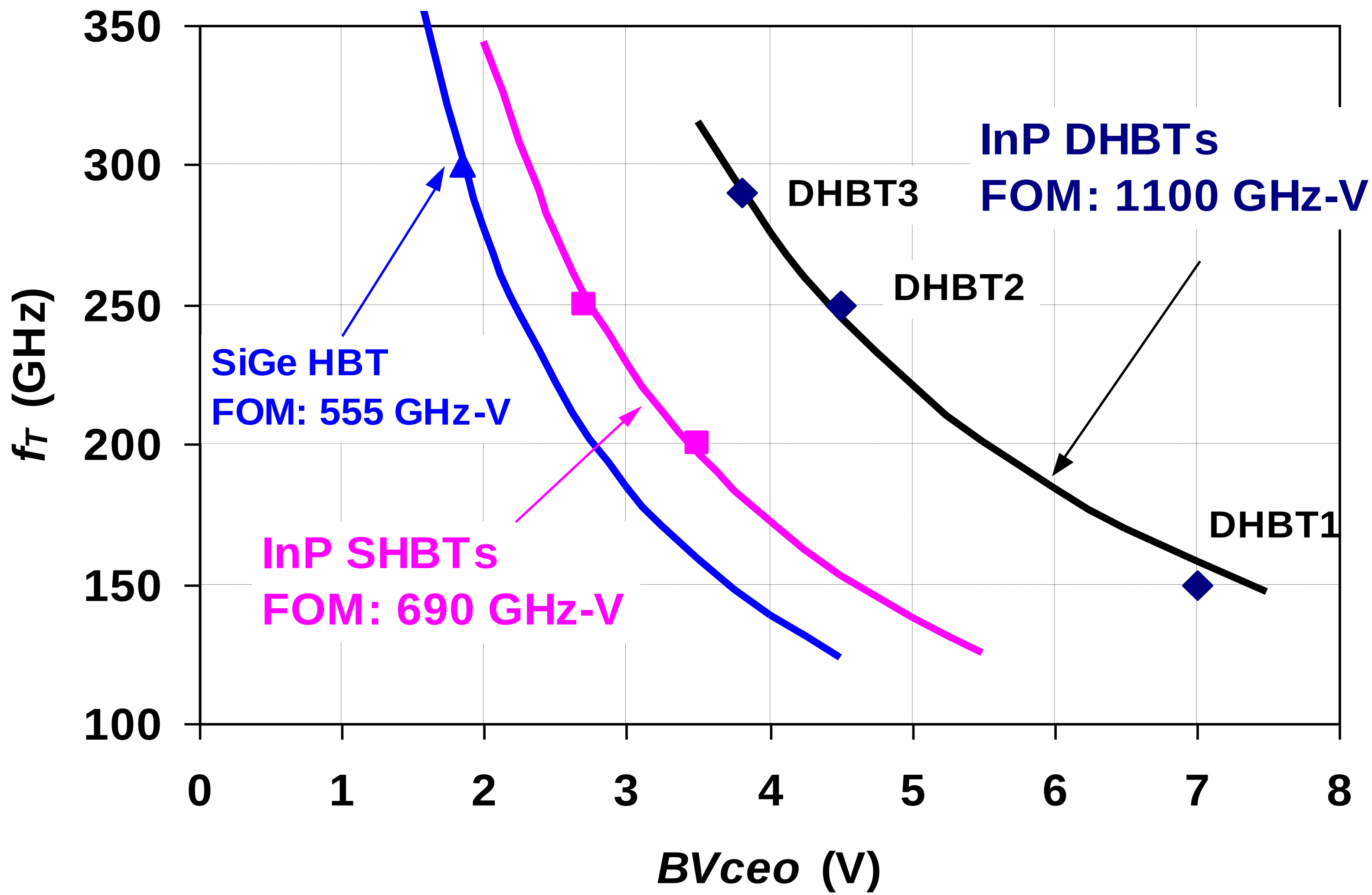
- GCS offers high-performance InP HBT technology for foundry service
- Four qualified processes are available for different applications
- Design kits and layout support are available
- Superior ICs have been demonstrated by customers and several have been in production since 2007

Advantages of InP HBT



Intrinsic material characteristics (hetero-junctions, high mobility, insulating substrate) and ease of integration (scalable) have made InP HBT the natural technology of choice for high performance circuits

Comparison of High Speed Technologies

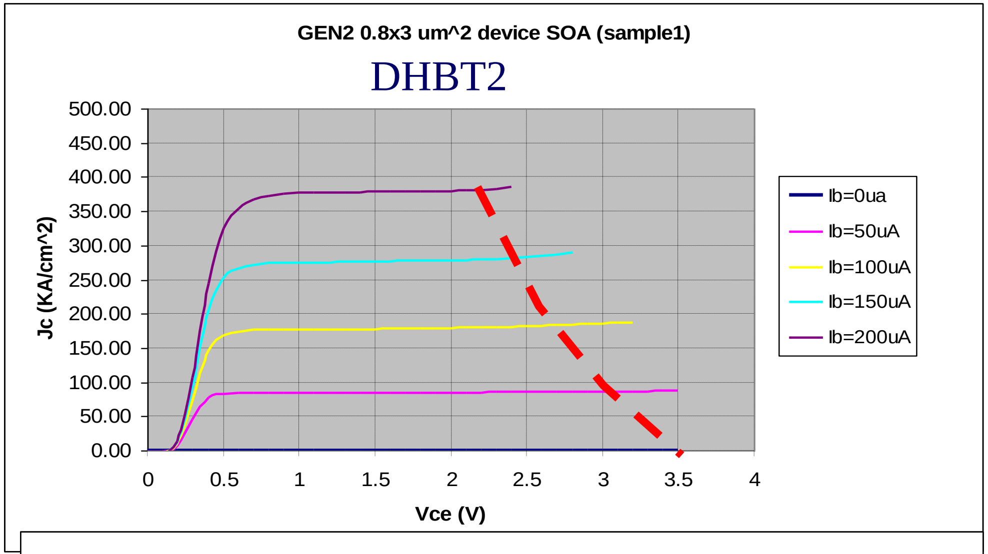


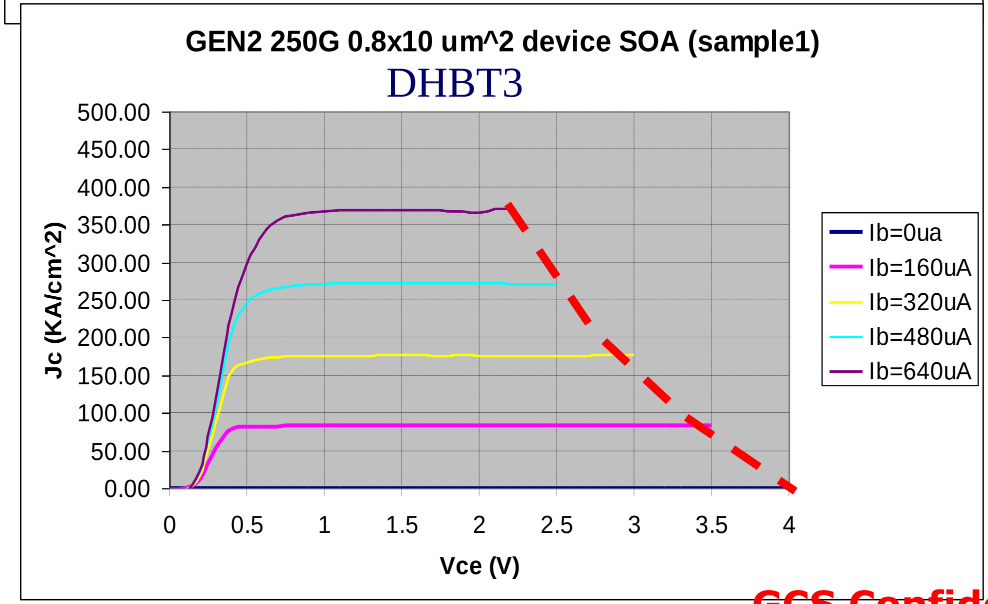
GCS InP HBT Parameters (Typical)

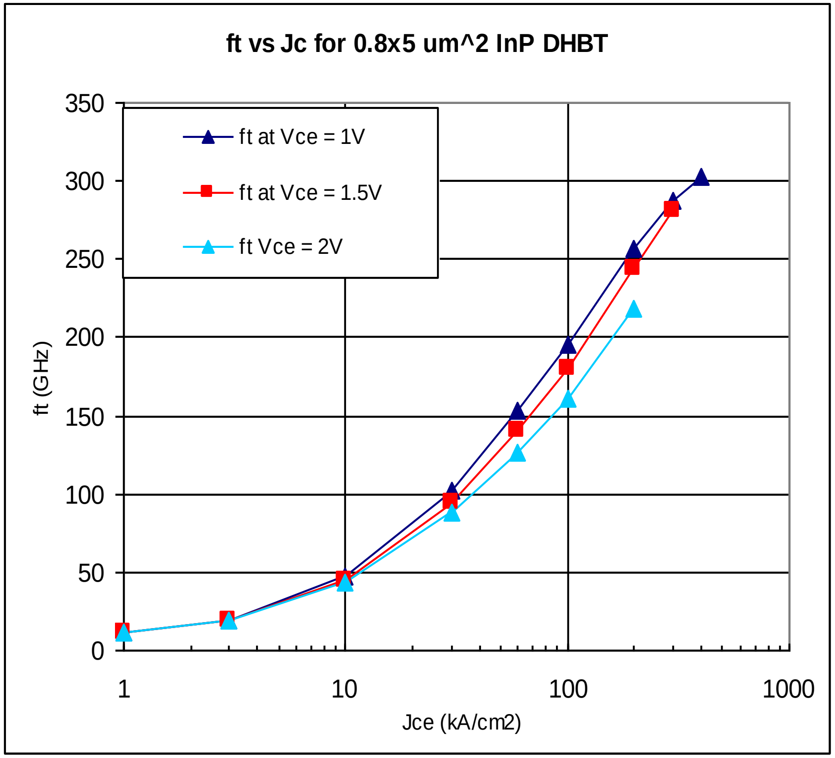
HBT Parameters		SHBT	DHBT1	DHBT2	DHBT3
Emitter Size		1umx3um	1umx3um	0.8umx3um	0.8umx3um
Typical operating current density	Jc(typ)	1mA/μm2	1 mA/μm2	2 mA/μm2	2 mA/μm2
Maximum operating current density	Jc(max)	2 mA/μm2	2 mA/μm2	3 mA/μm2	3 mA/μm2
Typical operating voltage	Vce	1 V	1.5V	1.5 V	1 V
Base-collector breakdown voltage	BVcbo	4 V	8 V	5.5 V	4.5 V
Collector-emitter breakdown voltage	BVceo	3.5 V	7 V	4.5 V	3.8 V
Emitter-base breakdown voltage	BVebo	2 V	2 V	2 V	2 V
Thermal resistance	Rth	9.9°C/mW	5.3°C/mW	5.3°C/mW	5.3°C/mW
fT (at Max allowed operating current)		180 GHz	150 GHz	250 GHz	300 GHz
fmax (at Max allowed operating current)		180 GHz	150 GHz	240 GHz	250 GHz

Passive Element Parameters	Typical Value
TaN TFR Sheet Resistance (Ohm/sq)	50
MIM Unit Capacitance (fF/μm2)	0.38
MIM Capacitance Breakdown Voltage (V)	-
Backside Vias	**Optional**

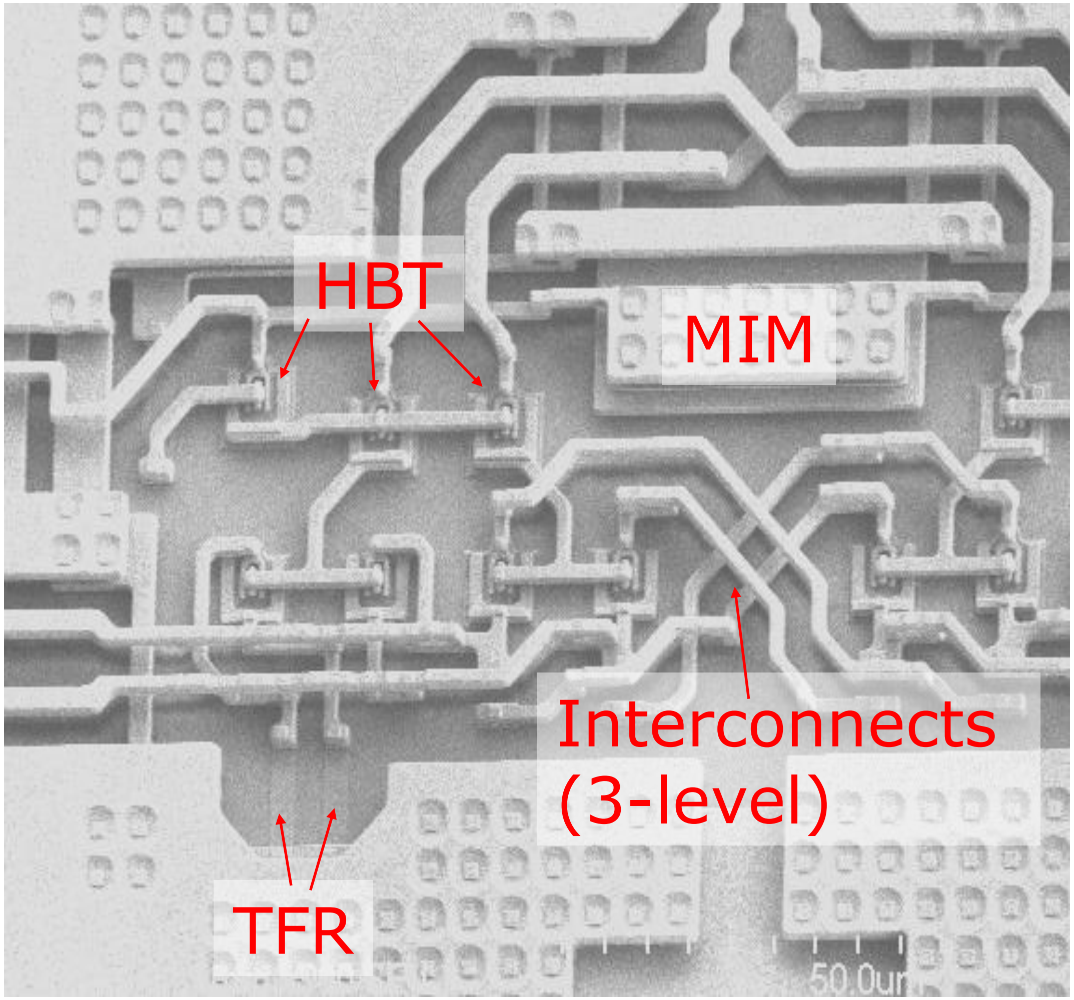
DHBT2 DC & RF Characteristics
- Extremely High Speed

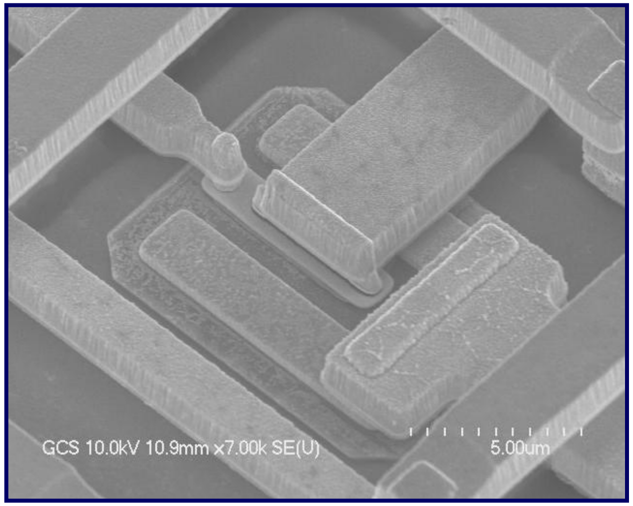


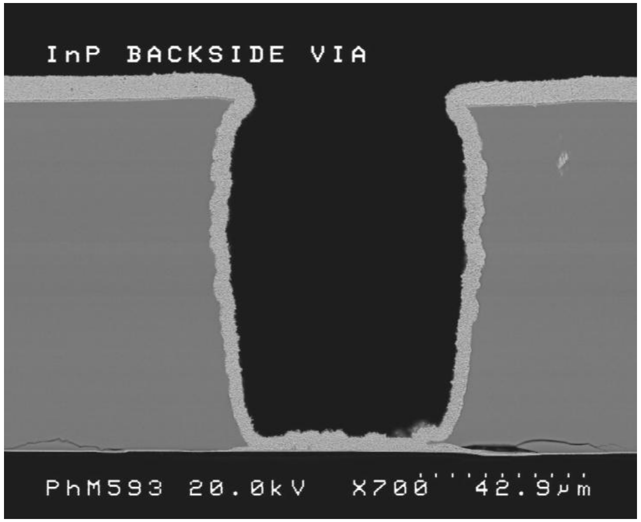




InP HBT MSI-Level Integration







Wafer Maps of High Beta InP HBT

Beta

W023			52.49	71.04	69.79			
	70.98	71.19	72.31	71.68	71.11	73.17	69.34	
73.62	72.53	72.82	71.07	70.95	72.31	71.61	73.06	69.94
73.25	73.48	72.95	71.65	71.04	71.12	72.54	74.01	72.38
73.28	74.17	72.36	71.4	71.93	71.23	69.2	71.46	72.56
74.53	73.66	73.28	72.54	72.58	70.14	69.76	69.96	71.04
71.69	74.8	74.37	74.23	72.69	73.71	72.93	71.77	68.63
	75.15	75.05	76.58	75.8	67.63	65.37	63.99	
		77.23	77.5	76.3	65.6			

Ave	71.81
Std	3.49
Uniformity (1std)	4.9%

Leading Edge Products Using GCS InP HBT

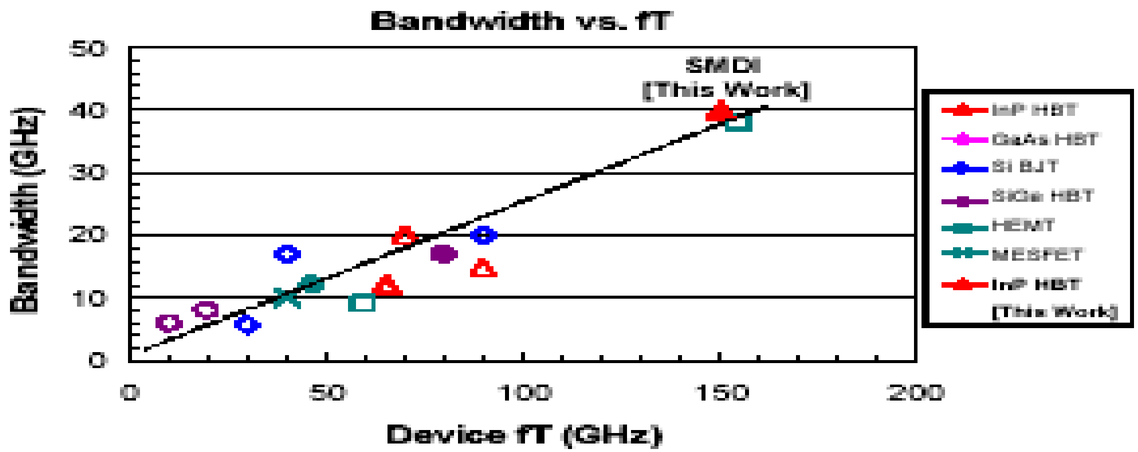


Fig. 2 Multiplier bandwidth vs. Device fT.

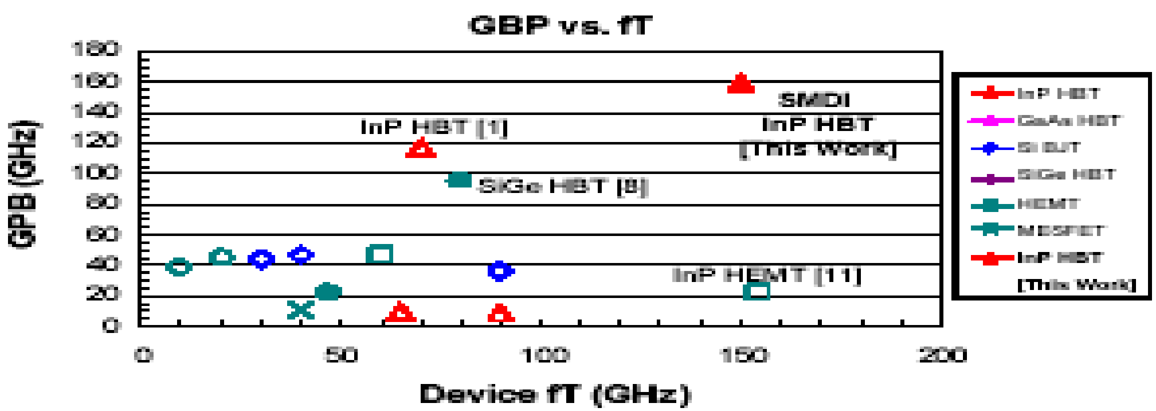
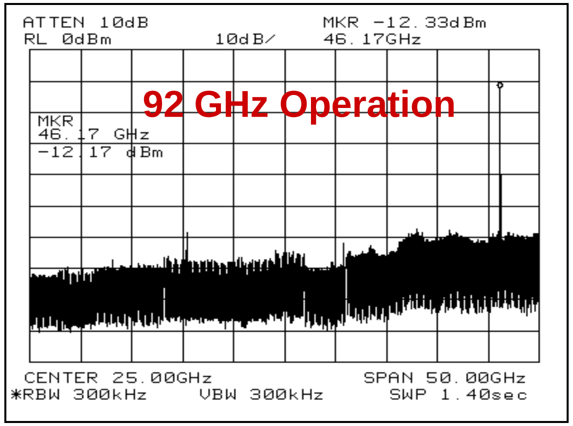
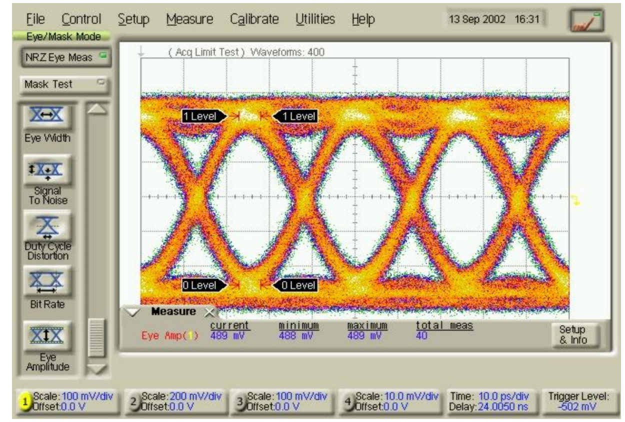


Fig. 3 Multiplier gain-bandwidth product vs. Device fT.

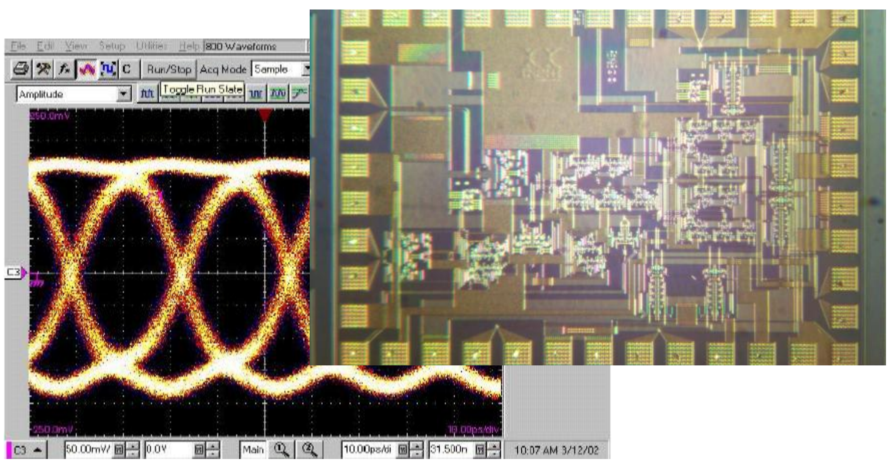
Leading Edge Products Using GCS InP HBT



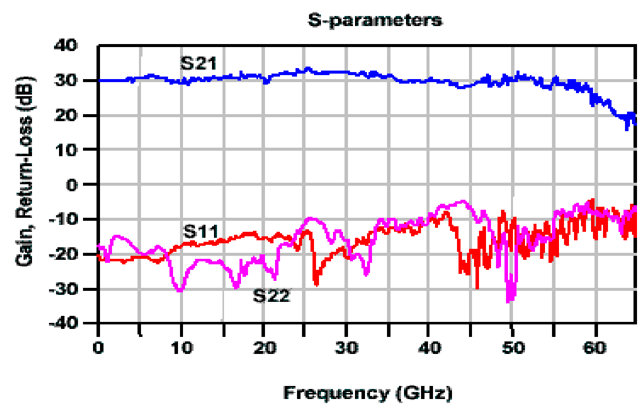
90 GHz Static Divider (courtesy of Inphi Corp)



40G Driver Circuit (courtesy of OpNext Corp)

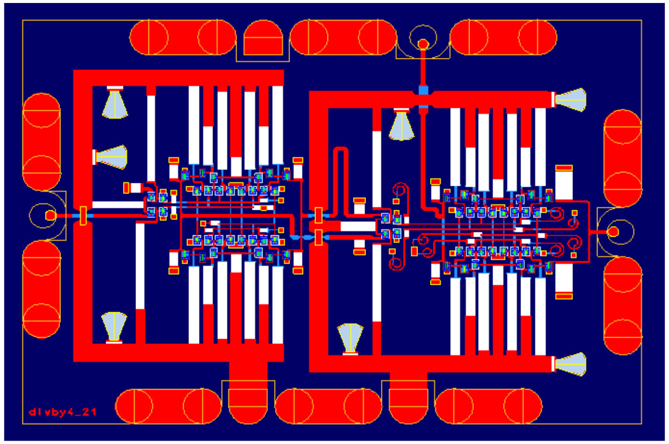


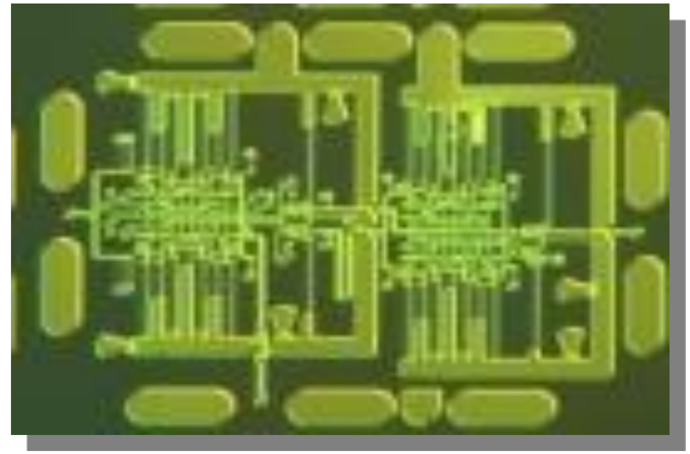
43 Gbps MUX (courtesy of Inphi Corp)



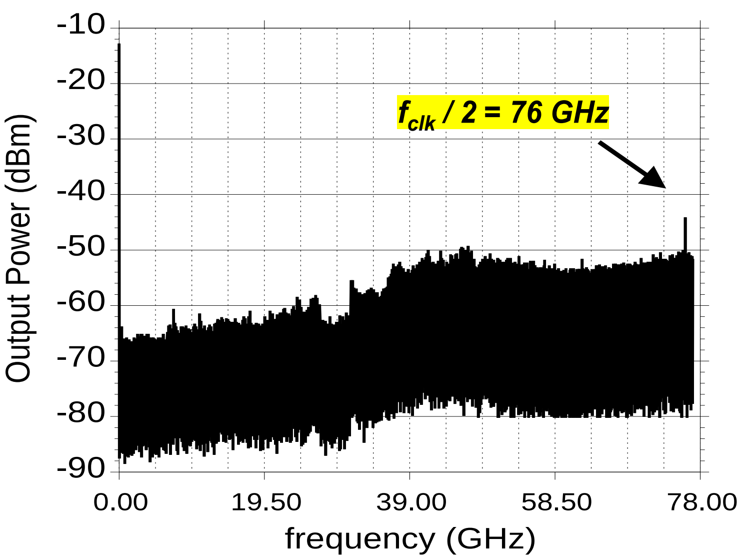
60 GHz TIA (courtesy of SMDI)

152 GHz InP HBT Static Frequency Divider (World Record)

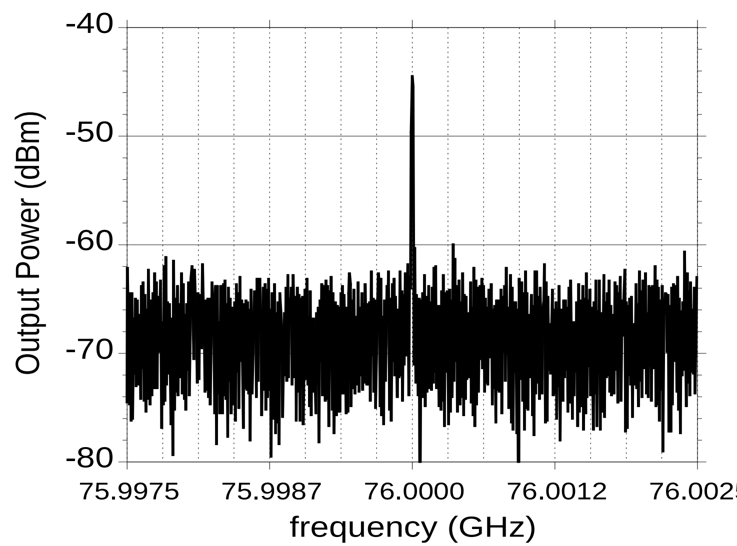




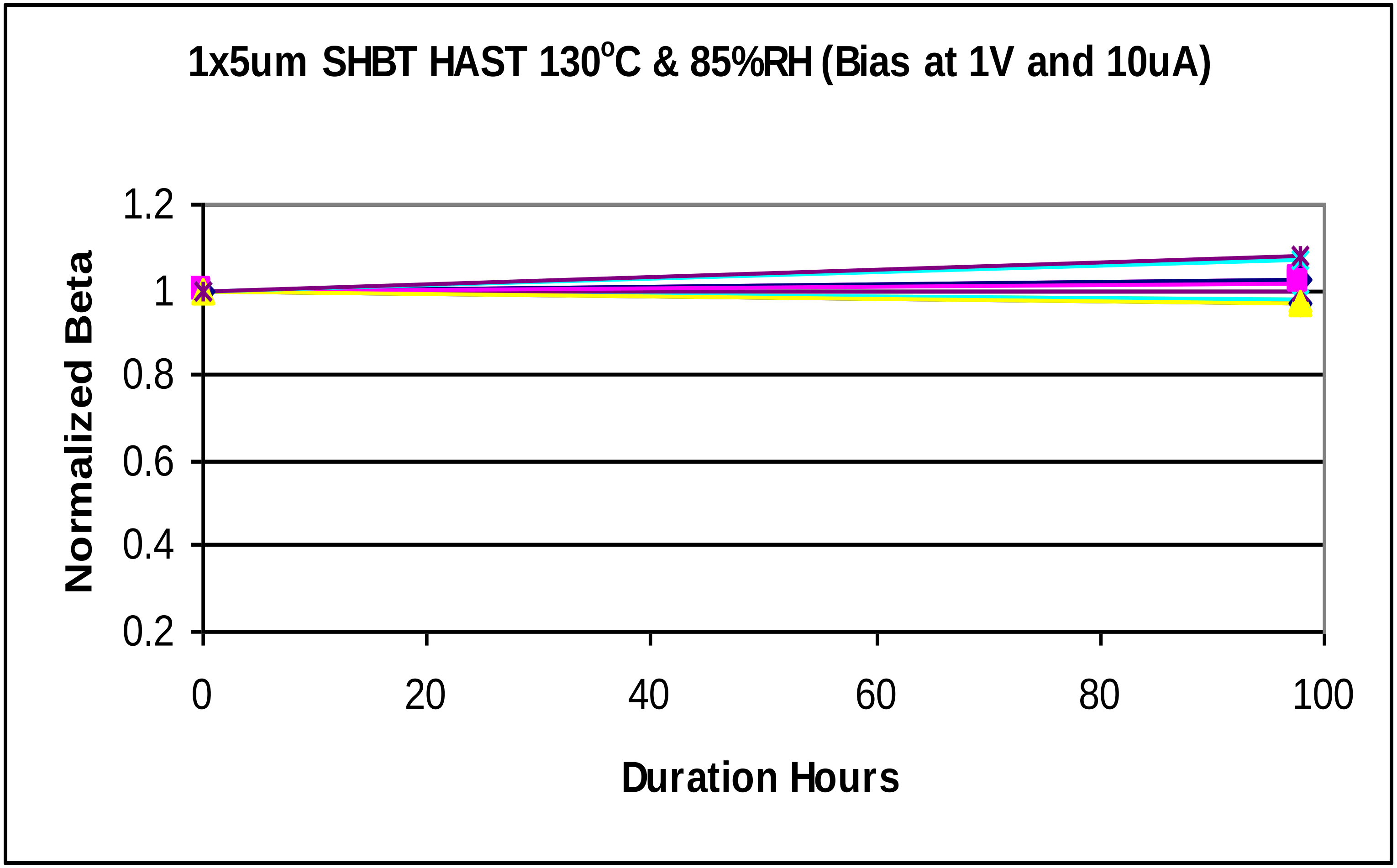
Span DC to 77 GHz



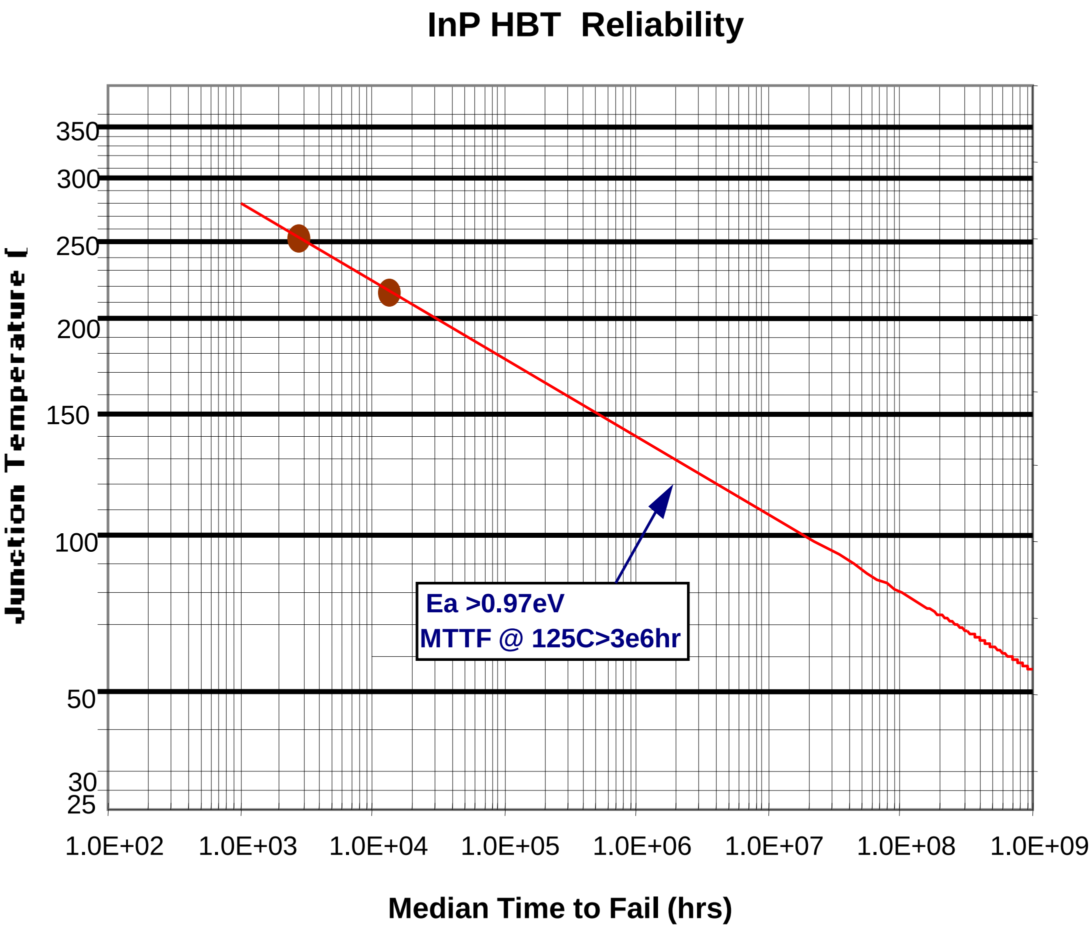
Span 5 MHz



GCS InP HBT Passed HAST Test (JESD22-A110-B)



Excellent InP HBT Reliability



- No low Ea (<0.5eV) failure mode occurred in our C-doped InP HBT
- Ea greater than 0.97eV and projected MTTF at 125°C is over 3 million hours under 150kA/cm^2 operation