5 Power Amplifier

回路図
4 stage PA

小信号利得

利得 [dBm]
- Measure
- Simulation
- Conv. Deem.

大信号利得

利得 [dBm]
- Measure
- Simulation

入力電力 Pin [dBm]

Chip 写真 (CMOS 65nm)

1.5mm × 0.85mm
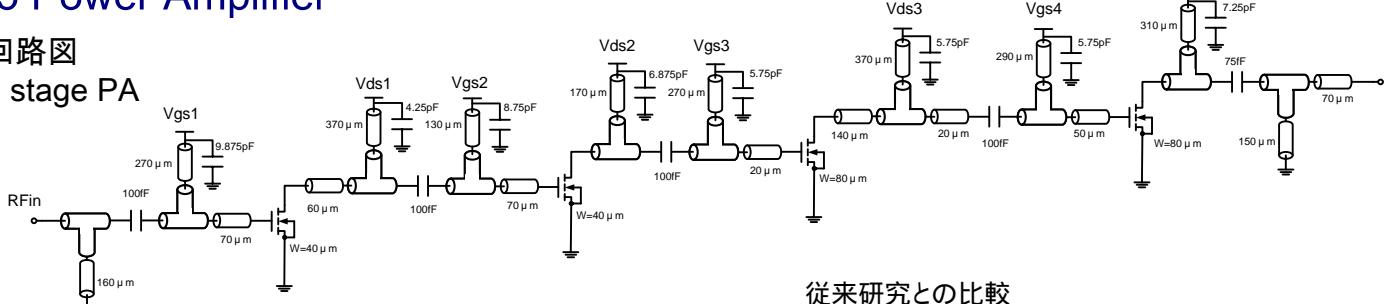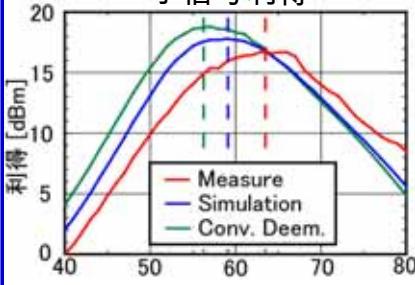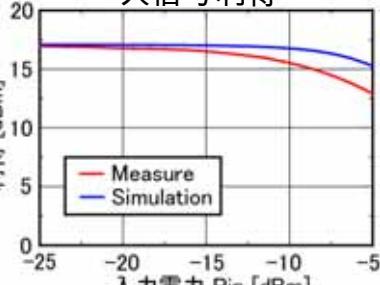
Reference	Technology	Freq. [GHz]	Gain [dB]	P1dB [dBm]	PAE@P1dB [%]	Pdc [mW]	VDD [V]
[1] JSSCC 2007	90nm CMOS	61	5.2	6.4	7.4	21	1.5
[2] RFIC 2008	90nm CMOS	63	14	11	15	81	1.2
[3] ISSCC 2008	90nm CMOS	60	8.2	8.2	2.4	229	1.2
[4] ISSCC 2008	90nm CMOS	60	5.5	9	6	80	1
[5] ISSCC 2008	90nm CMOS	60	13.3	10.5	8	150	1
[6] ISSCC 2009	65nm CMOS	60	15.8	2.5	3.95	43.5	1
[7] ISSCC 2009	45nm CMOS	60	13.8	11	-	-	1.1
[8] MWCL 2009	90nm CMOS	60	30	10.3	6	178	1.8
This work	65nm CMOS	61.5	16.4	4.6	2.3	122	1.2

[1] T.Yao, et al., JSSC 2007(Tronto Univ.) [2] T.L.Rocca, et al., RFIC 2008 (UCLA) [3] T.Suzuki, et al., ISSCC 2008 (Fujitsu)
[4] D. Chowdhury, et al., ISSCC 2008 (UCB) [5] M. Tanomura, et al., ISSCC 2008 (NEC)
[6] W.L. Chan, et al., ISSCC 2009 (Delft Univ.) [7] K. Raczkowski, et al., ISSCC 2009 (KU Leuven&IMEC)
[8] J.-L.Kuo, et al., MWCL 2009 (NTU)
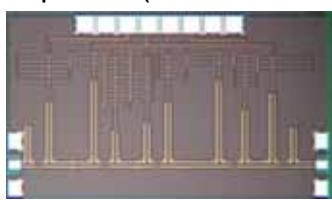
# 6 Up-Conversion Mixer

(Passive Mixer + Amp.)

Chip (CMOS 65nm)

0.76 mm × 0.53 mm

Sim.
IF:1GHz LO:60GHz(-1dBm)

☹
CG Pout1dB
LO Leak

	Measure	Simulation
CG [dB]	-6.7	-5.7
Pout1dB [dBm]	-14.5	-8.73
Pdc [mW]	49	55
LO Leak [dB]	-21.5	-29.4

7 Up-Conversion Mixer ver.2

(Gilbert Cell Mixer + RF Amp.)
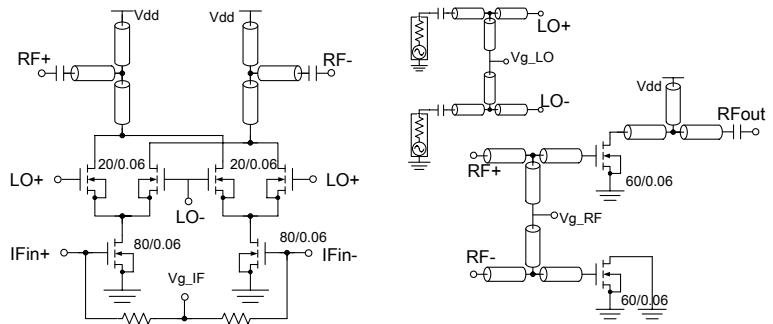
Reflection (LO port)   Reflection (LO port)

LO Leak

LO Leak [dB]
- R 有り
- R 無し

LO phase のミスマッチ [deg]

LO Leak
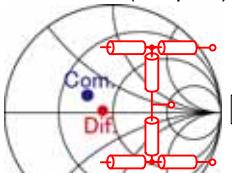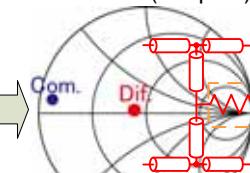
Reference	CMOS Node	DC Power [mW]	Supply Voltage[V]	RF [GHz]	LO P. [dBm]	CG [dB]	RF Output @1dB[dBm]	LO-RF Isolation[dB]
[1]RFIC2008	65nmCMOS	29	-	60	5	-6.5@IF=10GHz	-5	30
[2]ISCAS2007	90nmCMOS	70	1.5	60	-	-4 -7@IF=1GHz	-	-
[3]ESSCIRC2007	65nmCMOS	0	-	60	9	-13.5@IF=2GHz	-19	34
[4]Electronics Letters2008	130nmCMOS	24	1.6	56 65	0	-8 4@IF=1GHz	-5.6	37
[5]ISCAS2007	90nmCMOS	13.2	-	51	0	-11@IF=11GHz	-12	26.5
This work(Sim.)	65nmCMOS	33	1.2	61	-5	4@IF=1GHz	-6	38.2

[1] Alberto Valdes-Garcia, et al., RFIC 2008(IBM) [2] S.P.Voinigescu, et al., ISCAS 2008 (Univ. of Toronto) [3] Mikko Varonen, et al., ESSCIRC 2007 (Helsinki Univ. of Tech)
[4] F. Zhang, et al., EL 2008 (Univ. of Melbourne) [5] I. C. H. Lai, et al., ISCAS 2007 (The Univ. of Tokyo)

8 結論

60GHz   16QAM

PA   Meas.

PA   Up-Mixer