Low noise amplifier

SPECIFICATION

1 FEATURES

- TSMC CMOS 65 nm
- Operating frequency range 65…3000 MHz
- Single differential input
- High linearity
- High dynamic range
- Wide range variable gain -25…+20 dB
- Supported foundries: TSMC, UMC, Global Foundries, SMIC

2 APPLICATION

- Front-end high frequency signal amplification in receivers

3 OVERVIEW

Low-noise amplifier (LNA) is used to amplify weak signal at receiver input. LNA has a commutator to select necessary frequency sub-band and adjustable resonant circuit to fine-tune. Amplifier includes an integrated inductors and uses minimum off-chip components.
The LNA is designed using TSMC 65nm CRN65LP technology.

4 STRUCTURE

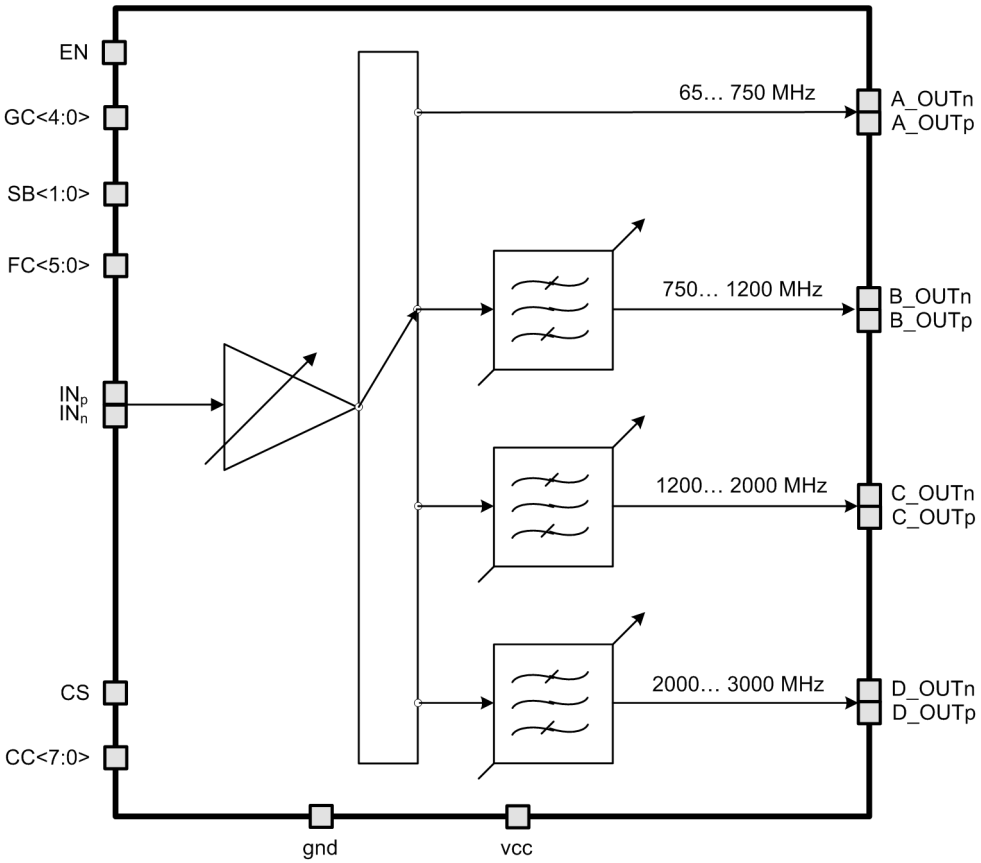

Figure 1: Low noise amplifier structure.

5 PIN DESCRIPTION

Name	Direction	Description
IREF_20u	IO	Reference current 20 µA
IN_p	I	Differential input (F = 65…3000 MHz)
IN_n	I	
EN	I	LNA enable/disable
GC<4:0>	I	Gain control
CC<7:0>	I	LNA current control
CS	I	Digital code defined the current source type (temperature independent/temperature dependent)
SB<1:0>	I	Subband select bit
FC<5:0>	I	Resonant circuit adjustment
A_OUT_n	O	LNA differential output (F = 65…750 MHz)
A_OUT_p	O	
B_OUT_n	O	LNA differential output (F = 750…1200 MHz)
B_OUT_p	O	
C_OUT_n	O	LNA differential output (F = 1200…2000 MHz)
C_OUT_p	O	
D_OUT_n	O	LNA differential output (F = 2000…3000 MHz)
D_OUT_p	O	
vcc	IO	Supply voltage
gnd	IO	Ground

6 LAYOUT DESCRIPTION

The block dimensions are given in the table 1.

Table 1: Block dimensions.

Dimension	Value	Unit
Height	2625	µm
Width	2030	µm

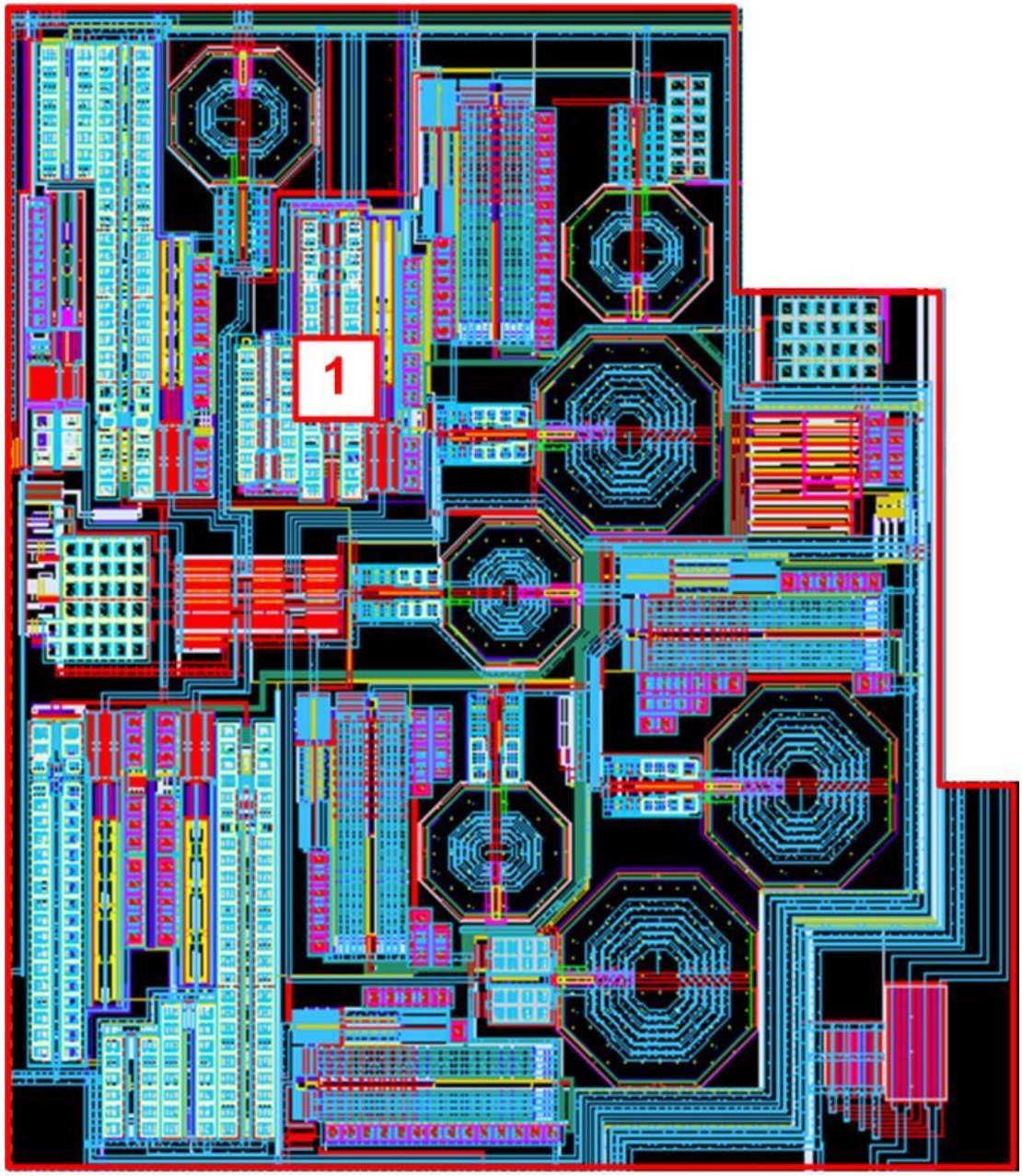

Figure 2: Low noise amplifier layout view.

1. LNA

7 OPERATING CHARACTERISTICS

7.1 TECHNICAL CHARACTERISTICS

Technology TSMC CMOS 65 nm
Status silicon proven
Area 5.1 mm^2

7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for V_{cc25} = 2.4÷2.6V and T = -40 ÷ +125°C. Typical values are at V_{cc25} = 2.5V, T =+85 °C, unless otherwise specified.

Parameter	Symbol	Condition		Value			Unit
				min	typ	max	
Supply voltage	V_{cc25}	-		2.4	2.5	2.6	V
Operating temperature range	T	-		-40	+85	+125	°C
Operating input frequency	F_A	-		65	-	750	MHz
	F_B	-		750	-	1200	
	F_C	-		1200	-	2000	
	F_D	-		2000	-	3000	
Bandwidth	B_w	-		-	200	-	MHz
Gain	G	GC=”11111”, 75Ω*	F_A	14.3	17.8	19.2	dB
			F_B	14.2	19.7	23.2	
			F_C	13.5	18.7	23.8	
			F_D	14.2	20.8	27.4	
Gain control range	GC	F_A		27.2	29.7	32.3	dB
		F_B		42.5	44.9	48.1	
		F_C		40.5	43.2	45.7	
		F_D		45.0	47.2	50.3	
Noise figure	NF	GC=”11111”, 75Ω*	F_A	3.4	3.7	4.5	dB
			F_B	3.7	4.2	5.2	
			F_C	4.6	5.1	6.0	
			F_D	4.9	5.3	7.2	
Input VSWR*	$VSWR_{IN}$	GC=”11111”, 75Ω*	F_A	3	3.2	3.7	-
			F_B	1.5	2.0	2.7	
			F_C	1.1	1.9	3.5	
			F_D	1.3	1.9	3.1	
Output impedance	R_{out}	75Ω*		-	800	-	Ω
Maximum input power	P_{max}	-		-	-	10	dBm
Input 1dB compression point	P_{1dB}	GC=”11111”, 75Ω*	F_A	-	-18	-	dBm
			F_B	-	-13	-	
			F_C	-	-15	-	
			F_D	-	-18	-	
Current consumption	I_{cc}	-		-	88.92	-	mA

* Measured with external components.

Note: Data in table are specified for the circuit with external transformer.

8 TYPICAL CHARACTERISTICS

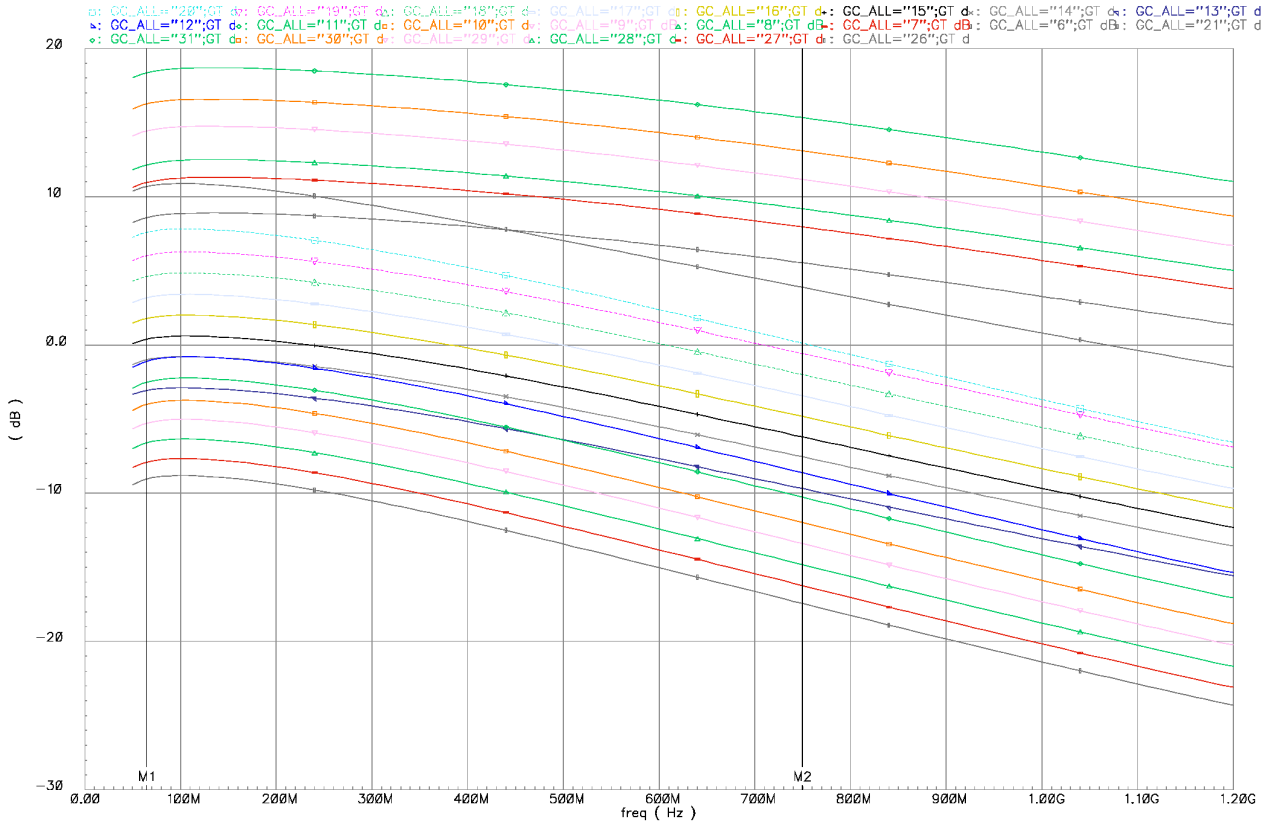

Figure 3: Gain vs gain control (GC) for F_A (65 – 750 MHz).

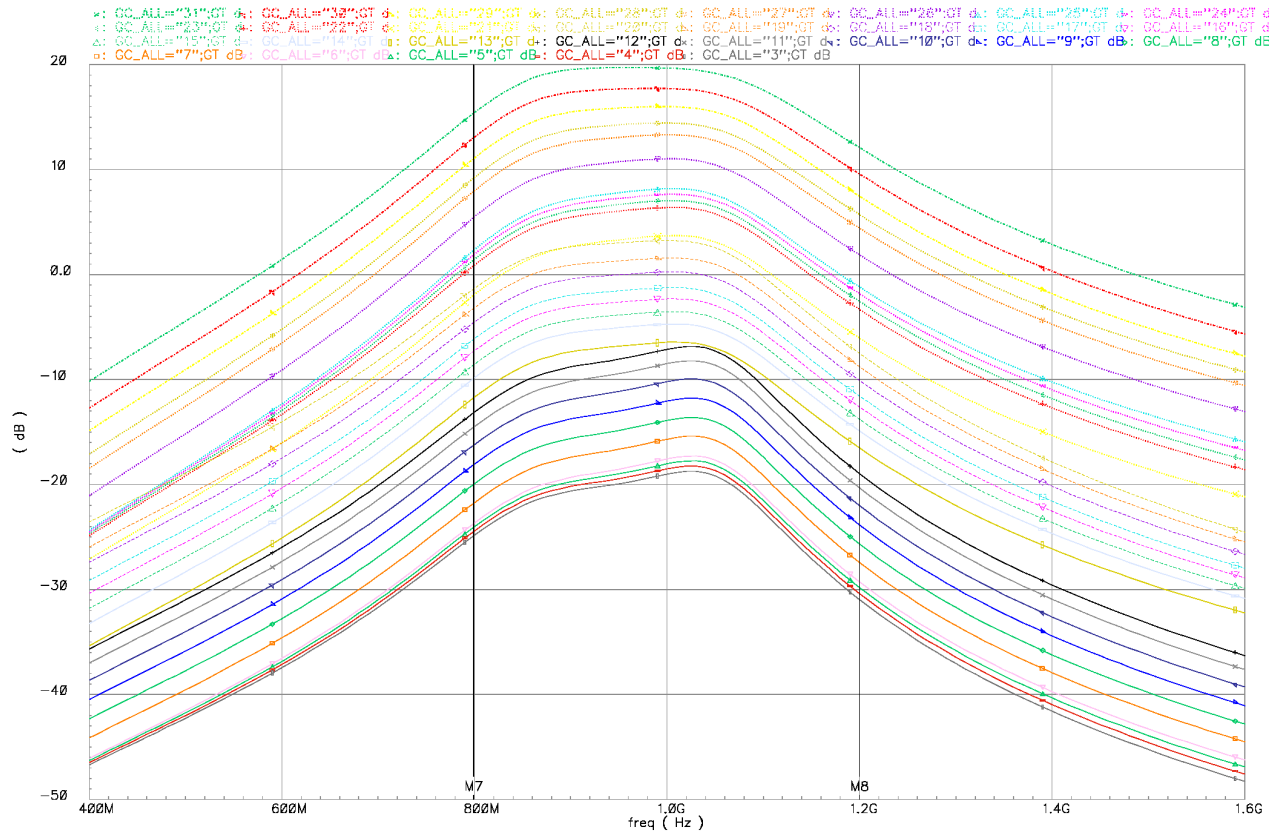

Figure 4: Gain vs gain control (GC) for F_B (750 – 1200 MHz).

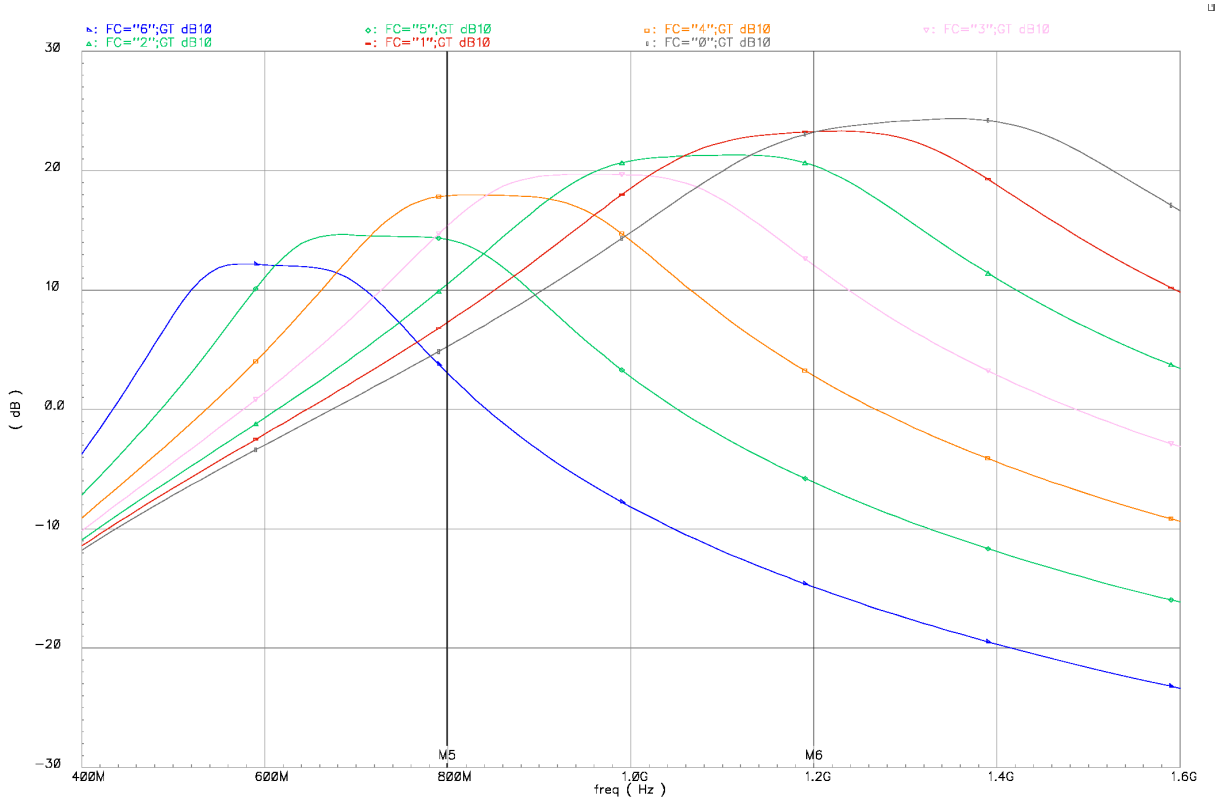

Figure 5: Gain vs resonant circuit adjustment (FC) for F_B (750 – 1200 MHz).

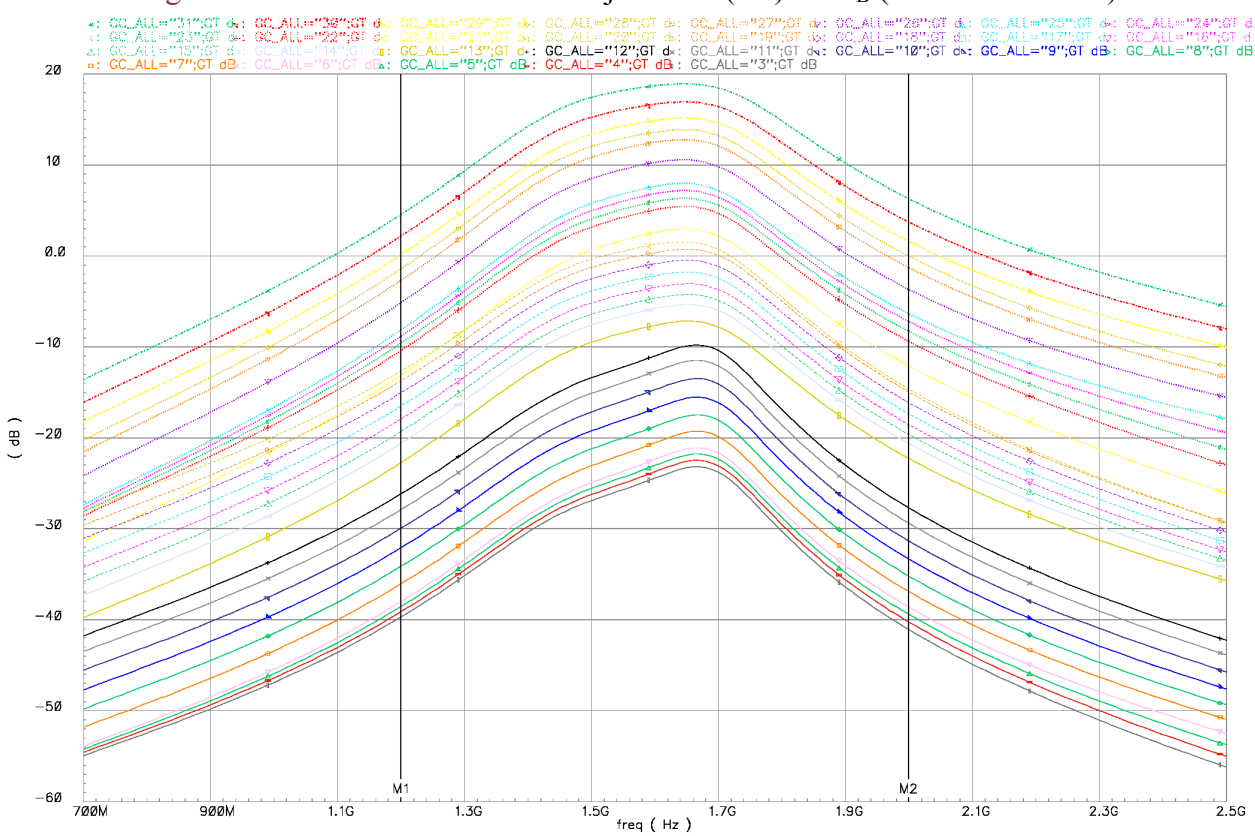

Figure 6: Gain vs gain control (GC) for F_C (1200 – 2000 MHz).

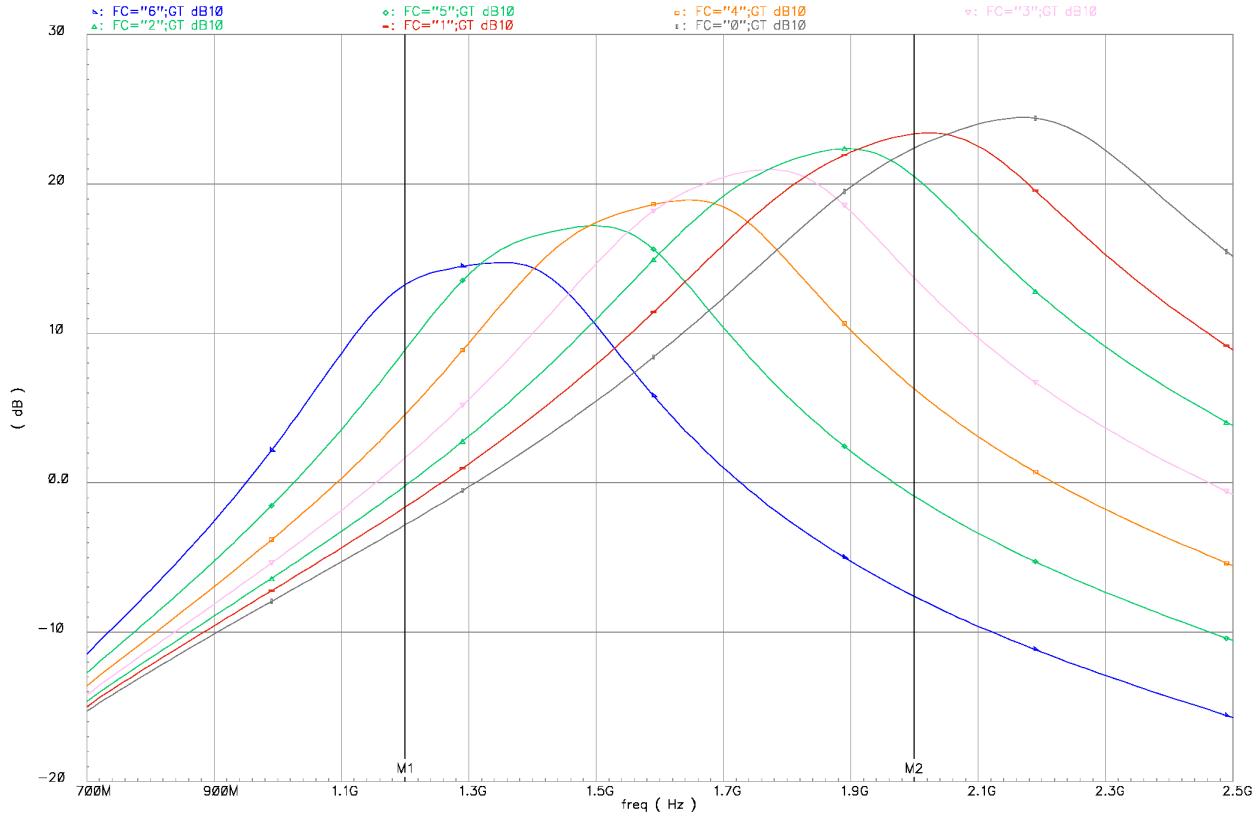

Figure 7: Gain vs resonant circuit adjustment (FC) for F_C (1200 – 2000 MHz).

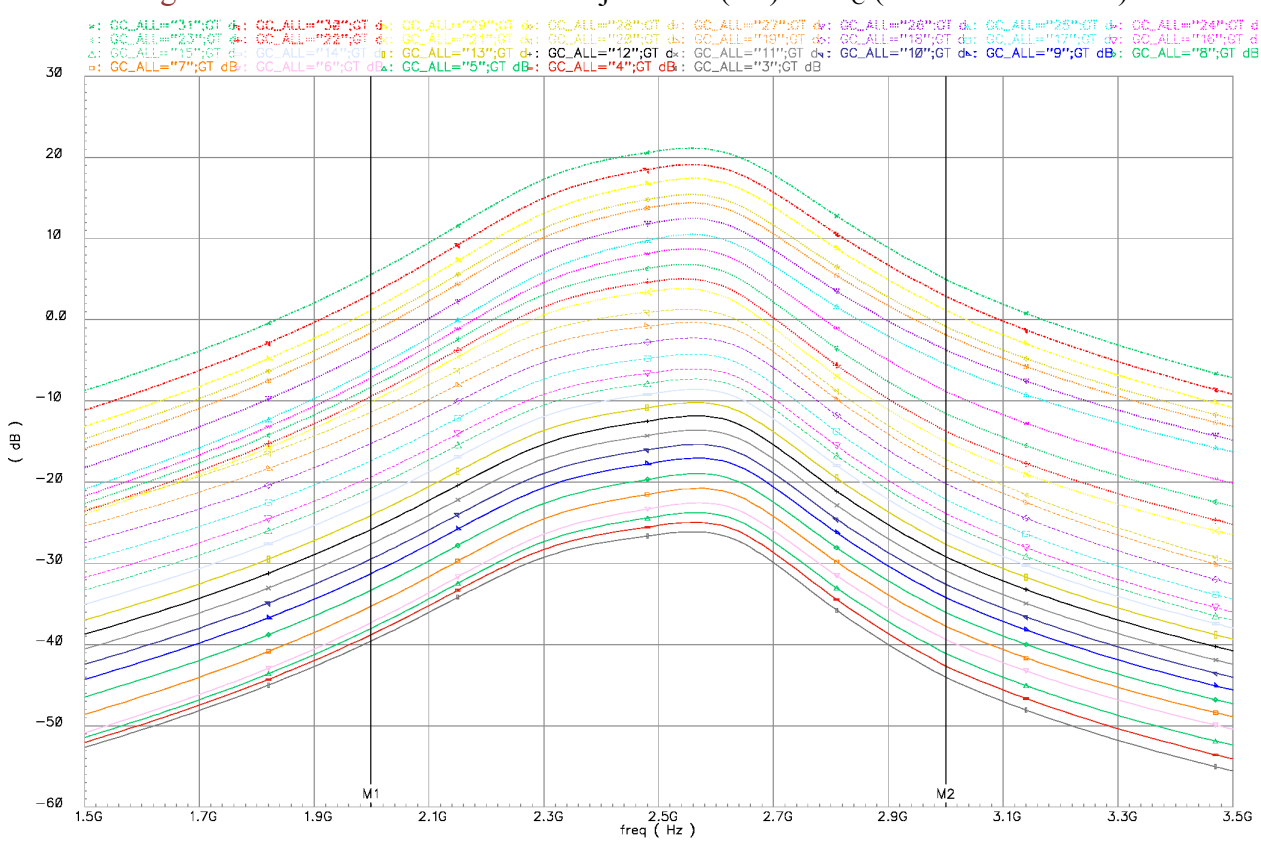

Figure 8: Gain vs gain control (GC) for F_D (2000 – 3000 MHz).

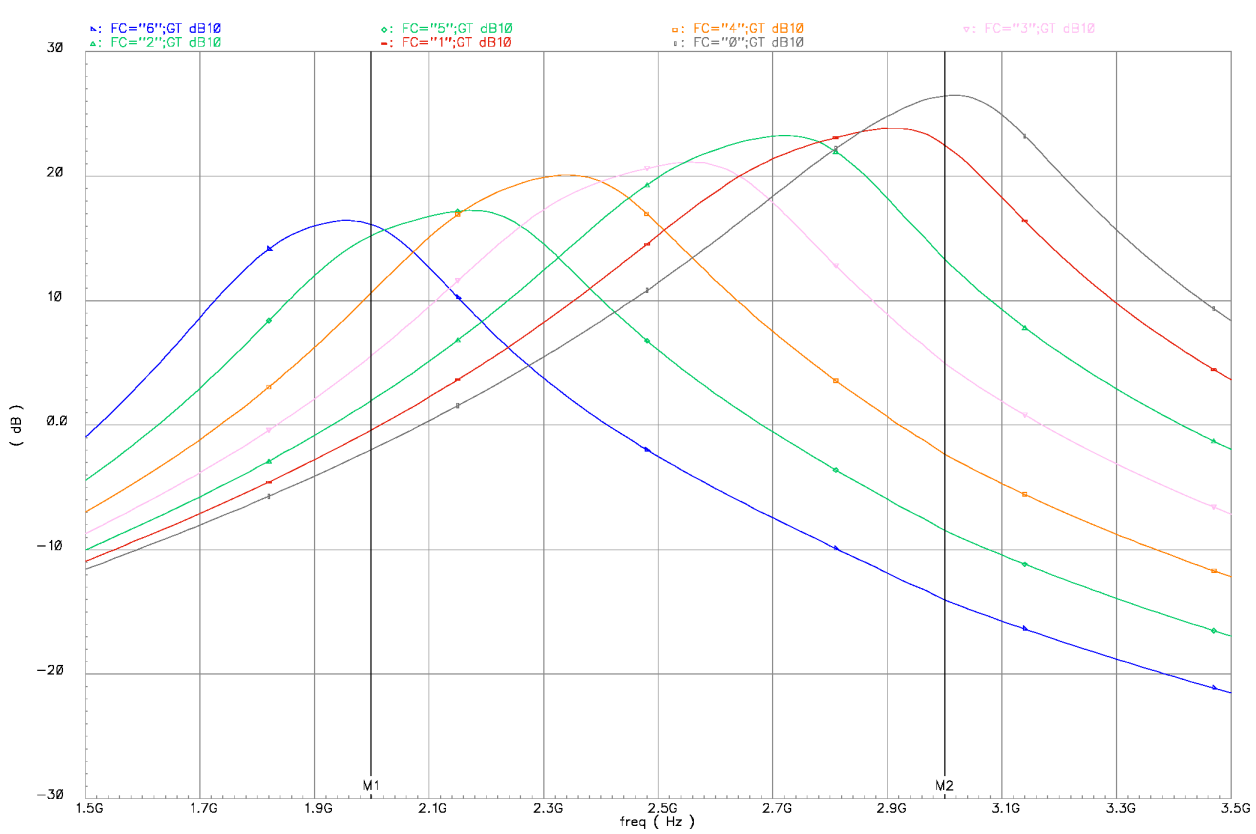

Figure 9: Gain vs resonant circuit adjustment (FC) for F_D (2000 – 3000 MHz).

9 DELIVERABLES

IP contents:

- Schematic or NetList
- Layout or blackbox
- Extracted view (optional)
- GDSII
- DRC, LVS, antenna report
- Test bench with saved configurations (optional)
- Documentation