Single Stage LNA – Objectives

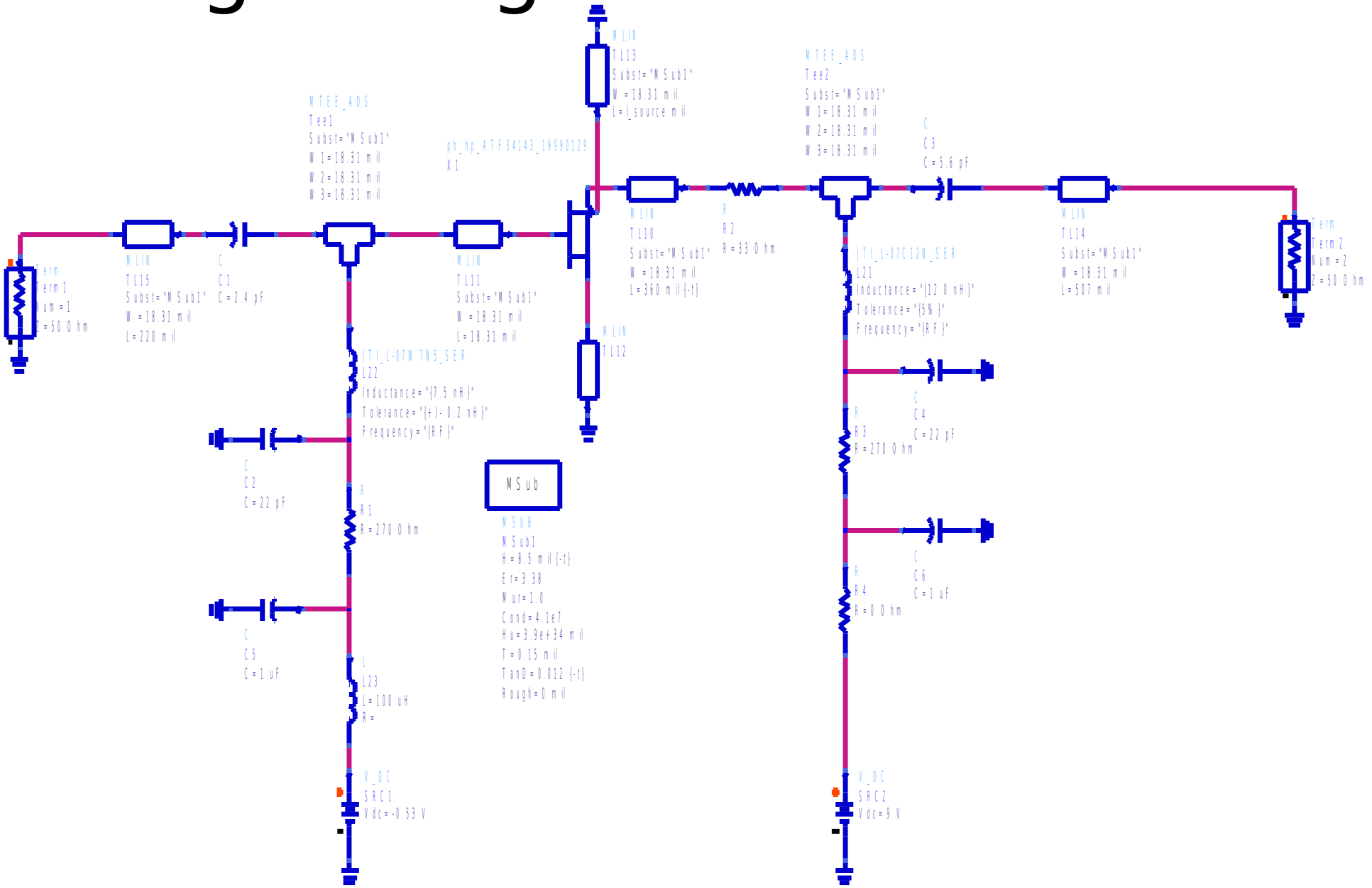
on behalf of Torsten Bacher, ATMEL Dresden

- Design of a low noise amplifier with noise figure target of less than 0.4 dB
- Implementation within antenna feed to avoid any cable, adapter or connector between antenna and LNA
- All additional passive components in front of the first amplifier stage will increase noise figure according to their insertion loss
- Small design required -> single stage for integration inside antenna
- Design on RF PCB material RO4003 due to less loss (tan δ = 0.027) versus FR4 (tan δ = 0.0027)
- Avago transistor ATF34143 chosen because of its typical noise parameter (F_{min} = 0.14 dB @ 1.5 GHz, U_{DS} = 3 V, I_D = ´20 mA)
- Negativ gate biasing voltage required, ICL7660 used to supply negative voltage

Single Stage LNA - Objectives

- Self-biasing transistor stage with disadvantage of worse input reflection S11
- Source transmission lines used to deal with S11 versus input noise matching
- S11 target < 8 dB
- Source transmission lines improve Rollet stability factor at low frequencies (<5 GHz)
- Low pass matching filters and drain resistor required for better stability
- Rollet factor target < 1 for unconditional stability
- Unconditional stability required because of unknown load impedance/ unknown bandpass filter design

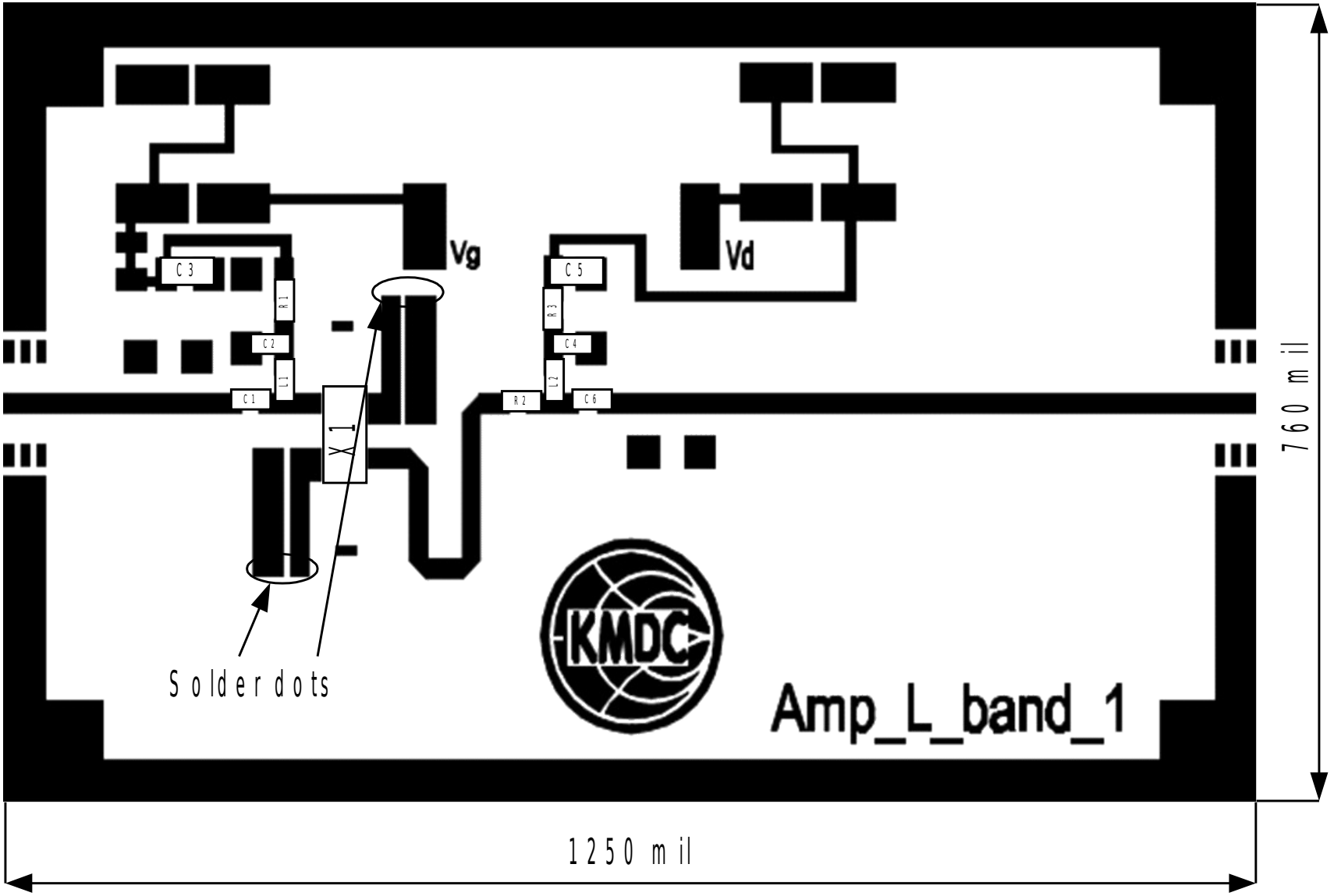
Single Stage LNA - Schematic



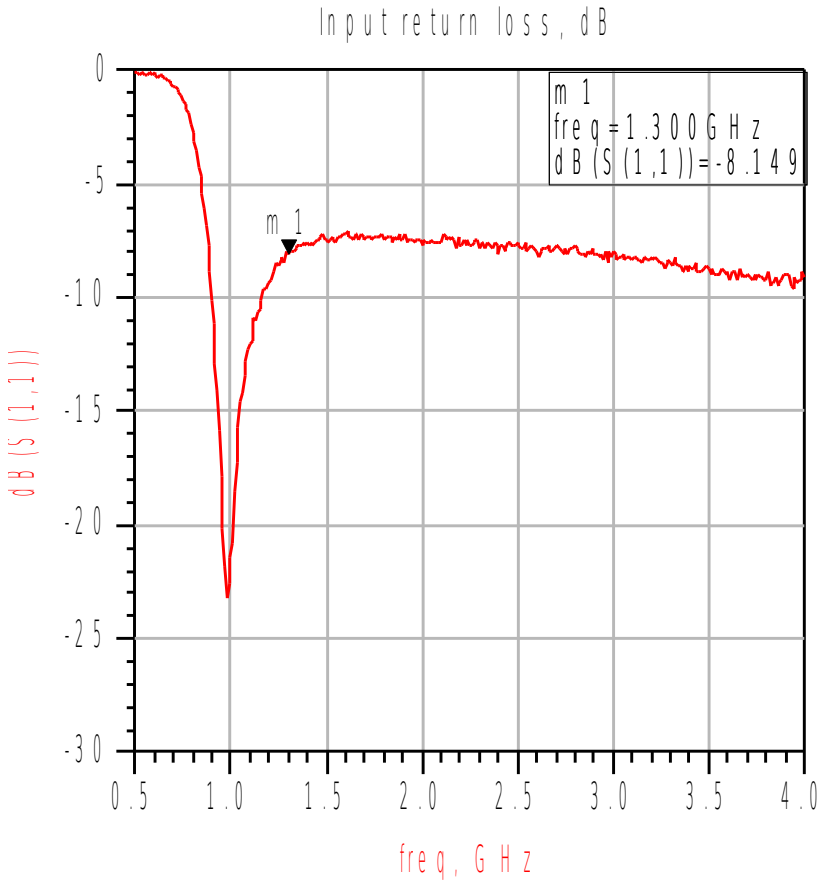
Single Stage LNA - Components

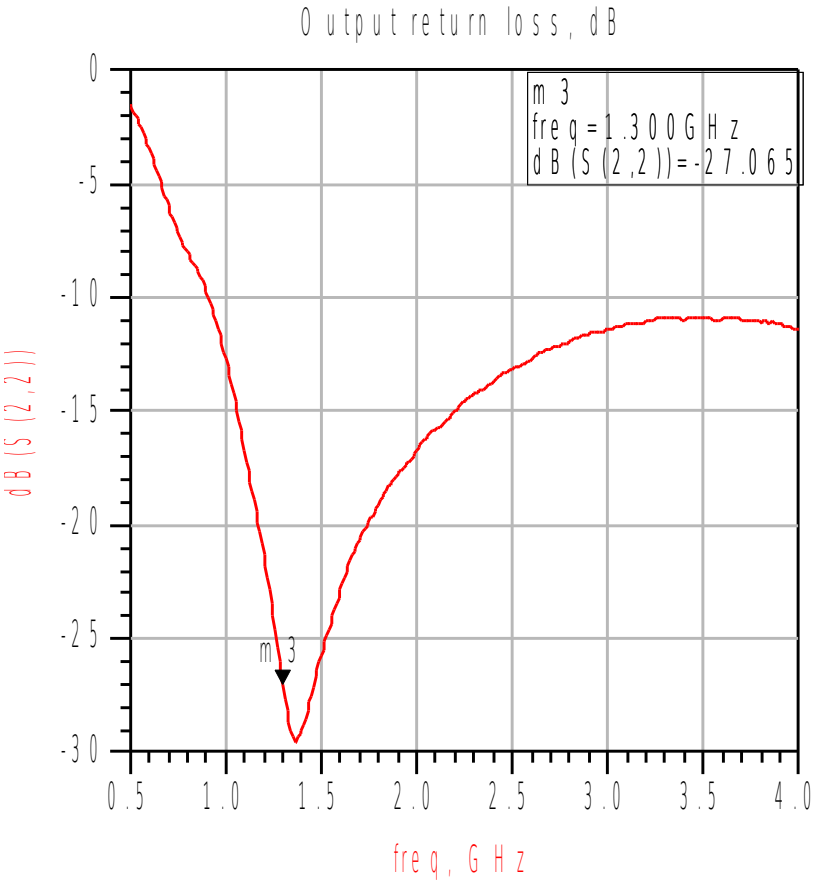
Designator	Description	Value	Manufacturer	Part Number	Comment		
C1	Decoupling/Matching capacitor	2.4 pF	Johanson Technologies	500R07S2R4BV4S	0402	±0.1 pF	
C2, C4	Low pass capacitor	22 pF	Taiyo Yuden	UMK 105 CH220JW	0402		50 V
C3, C5	Bypass capacitor	1 µF			0805		
C6	Decoupling/Matching capacitor	5.6 pF	Johanson Technologies	500R07S5R6BV4S	0402	±0.1 pF	
L1	Matching/Bias feed inductance	7.5 nF	Johanson Technologies	L-07W 7N5JV4S	0402	2%	Wire-wound
L2	Matching/Bias feed inductance	12 nF	Johanson Technologies	L-07W 12NJV4S	0402	2%	Wire-wound
R1, R3	Decoupling resistor	270 Ω	Tyco Electronics		0402	1%	
R2	Stability resistor	33 Ω	Tyco Electronics		0402	1%	
TL1	Input transmission line	220 mil			18.31 mil	50 Ω	
TL3, TL4	Source line	90 mil			18.31 mil	50 Ω	
TL5	Drain line	360 mil			18.31 mil	50 Ω	
TL6	Output transmission line	507 mil			18.31 mil	50 Ω	

Single Stage LNA – Layout on RO4003

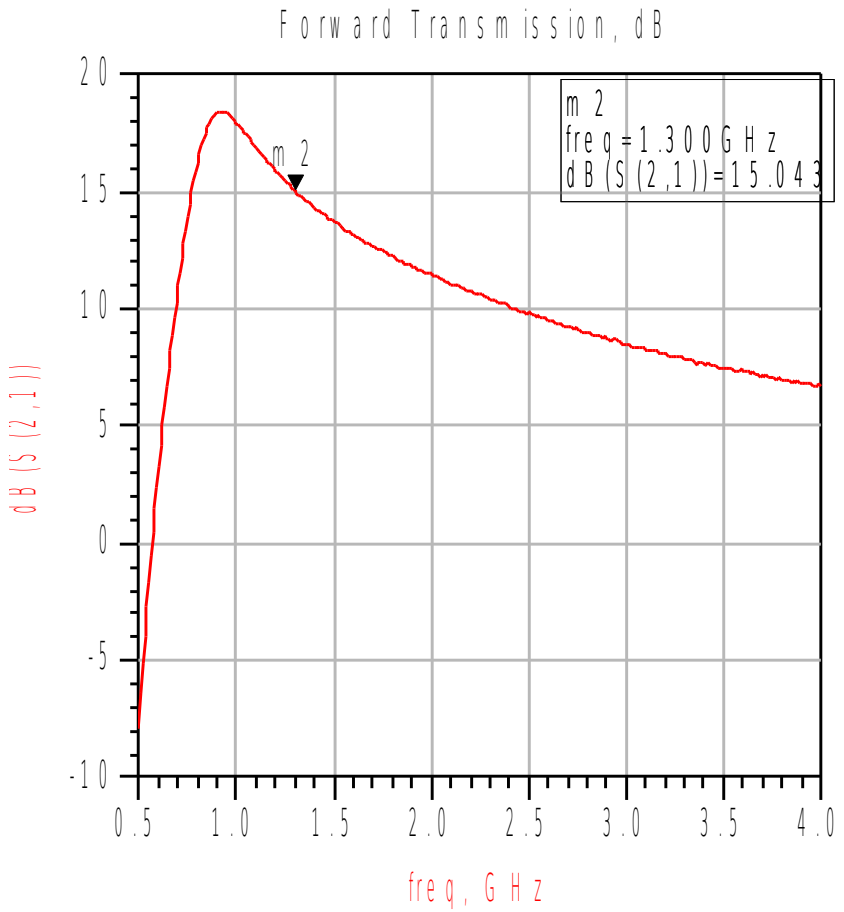


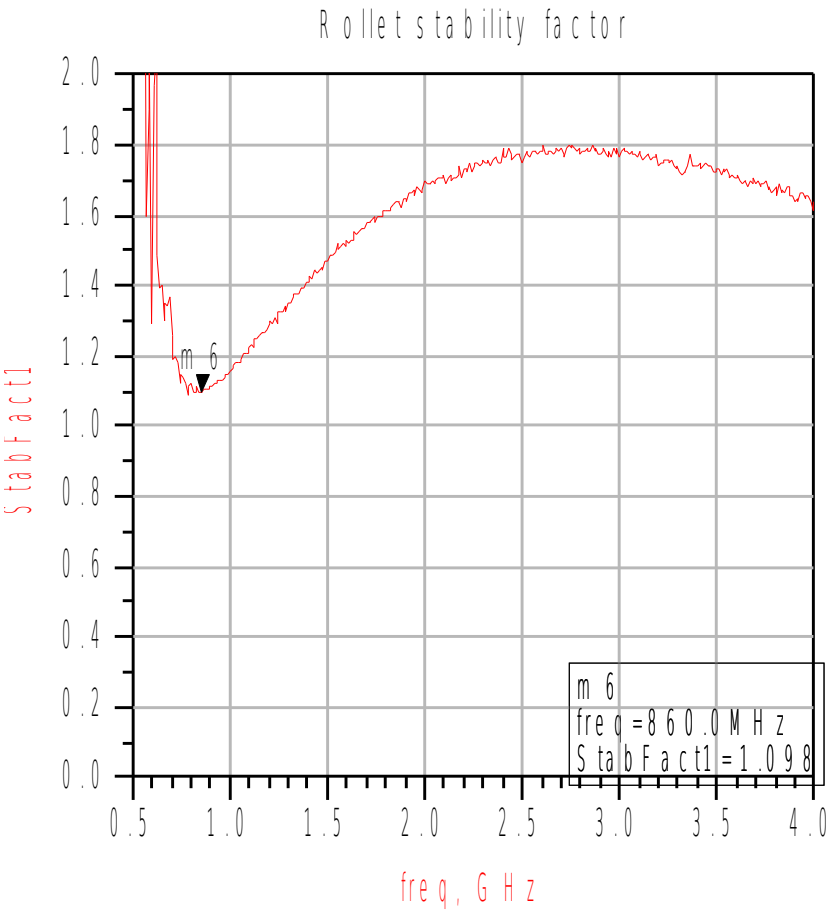
Measured input and output matching





Measured Gain and stability factor





Measured noise figure 0.7 dB :-(