

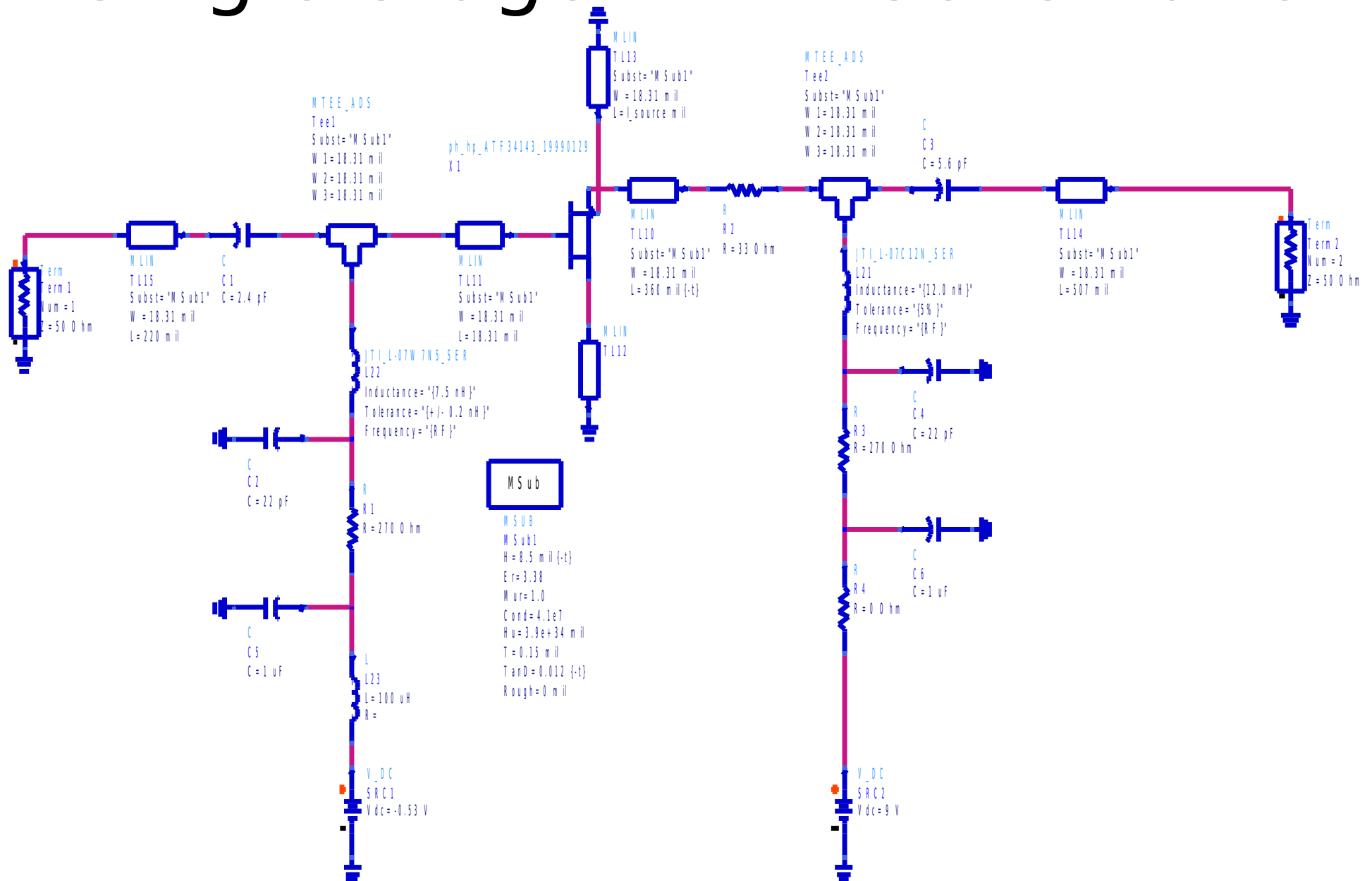
Single Stage LNA - Objectives

- 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 ($\tan \delta = 0.0027$) versus FR4 ($\tan \delta = 0.0027$)
- 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)
- Negative gate biasing voltage required, ICL7660 used to supply negative voltage

Single Stage LNA - Objectives

- Self-biasing transistor stage with disadvantage of worse input reflection S_{11}
- Source transmission lines used to deal with S_{11} versus input noise matching
- S_{11} 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

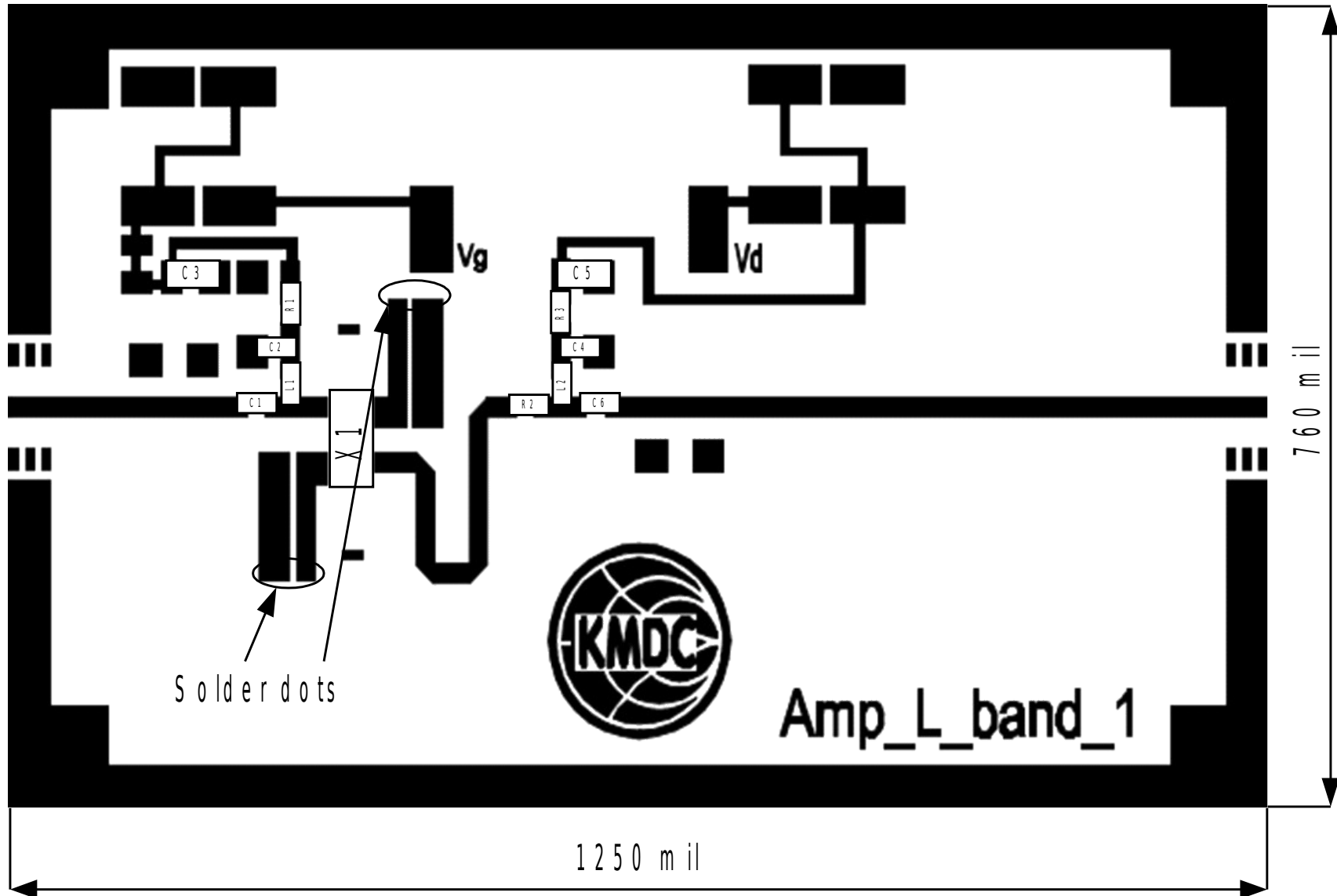
Single Stage LNA - Schematic



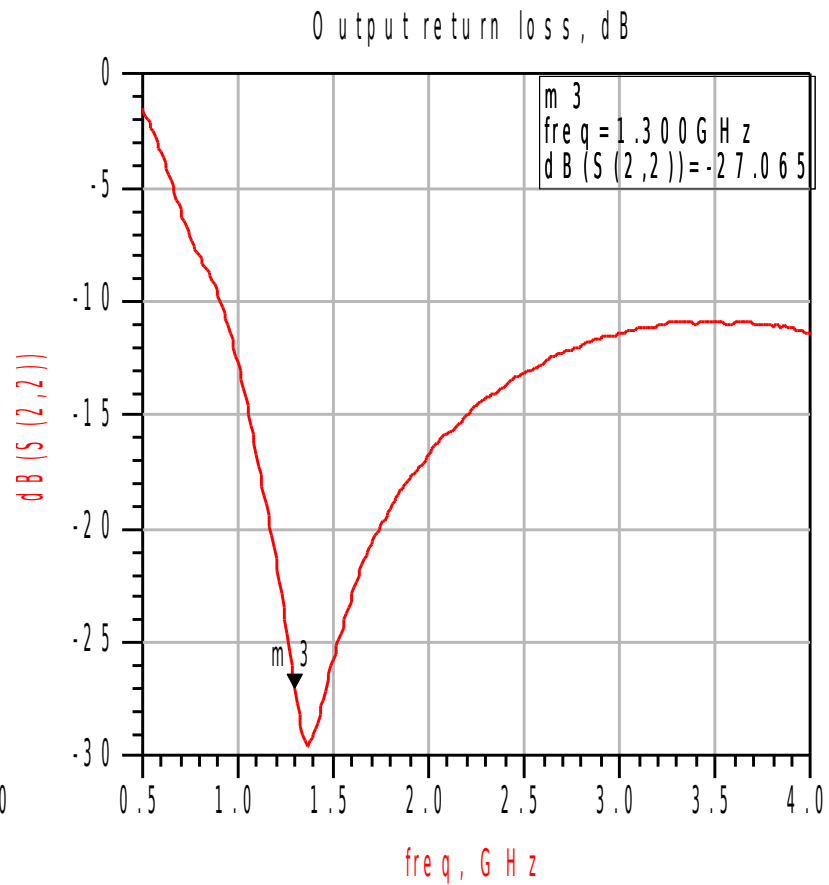
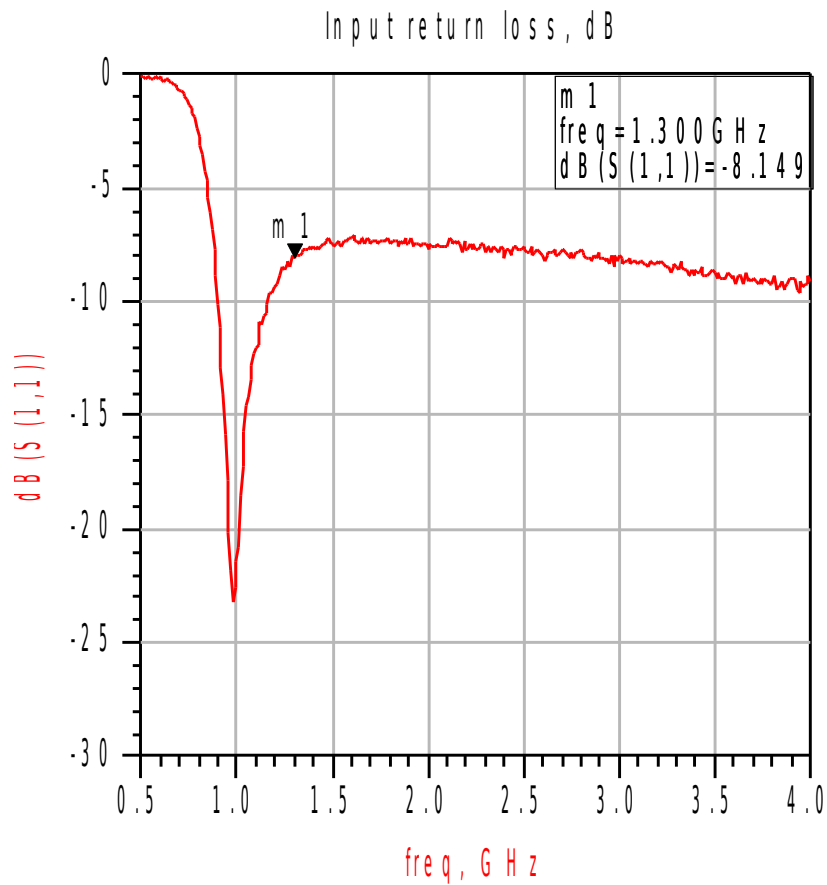
Single Stage LNA - Components

Designator	Description	Value	Manufacturer	Part Number	Comment		
C 1	Decoupling / Matching capacitor	2.4 pF	Johanson Technologies	500R07S2R4BV4S	0402	±0.1 pF	
C 2, C 4	Low pass capacitor	22 pF	Taiyo Yuden	UMK105CH220JW	0402		50 V
C 3, C 5	Bypass capacitor	1 μF			0805		
C 6	Decoupling / Matching capacitor	5.6 pF	Johanson Technologies	500R07S5R6BV4S	0402	±0.1 pF	
L 1	Matching / Bias feed inductance	7.5 nF	Johanson Technologies	L-07W7N5JV4S	0402	2%	Wire-wound
L 2	Matching / Bias feed inductance	12 nF	Johanson Technologies	L-07W12NJV4S	0402	2%	Wire-wound
R 1, R 3	Decoupling resistor	270 Ω	Tyco Electronics		0402	1%	
R 2	Stability resistor	33 Ω	Tyco Electronics		0402	1%	
TL 1	Input transmission line	220 mil			18.31 mil	50 Ω	
TL 3, TL 4	Source line	90 mil			18.31 mil	50 Ω	
TL 5	Drain line	360 mil			18.31 mil	50 Ω	
TL 6	Output transmission line	507 mil			18.31 mil	50 Ω	

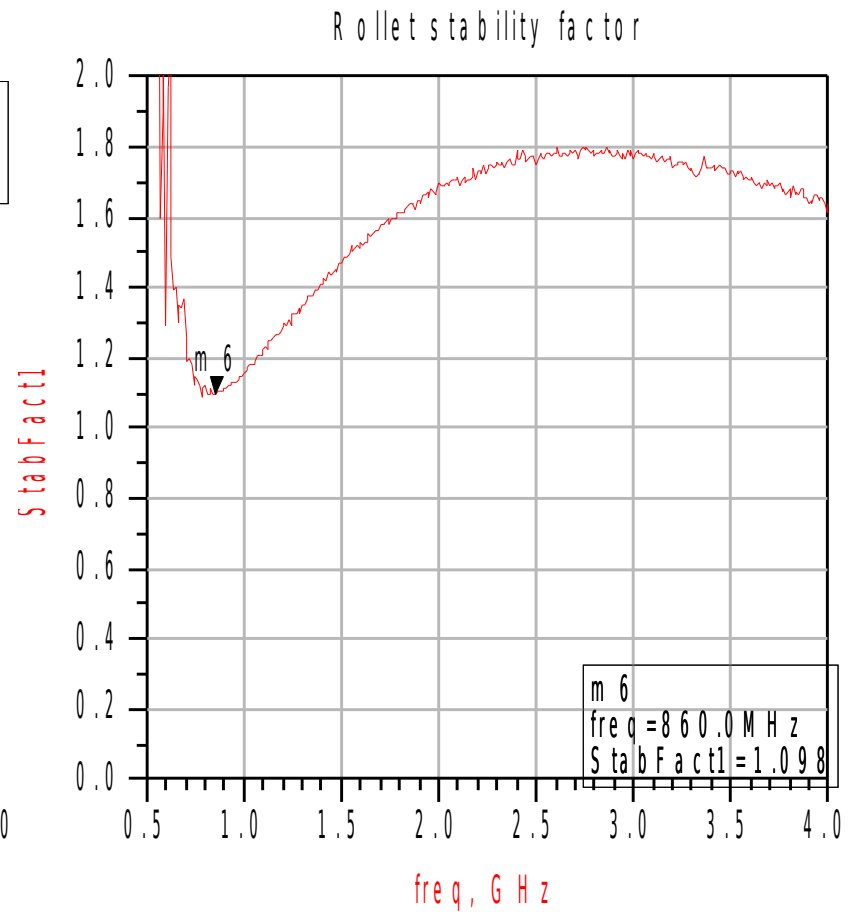
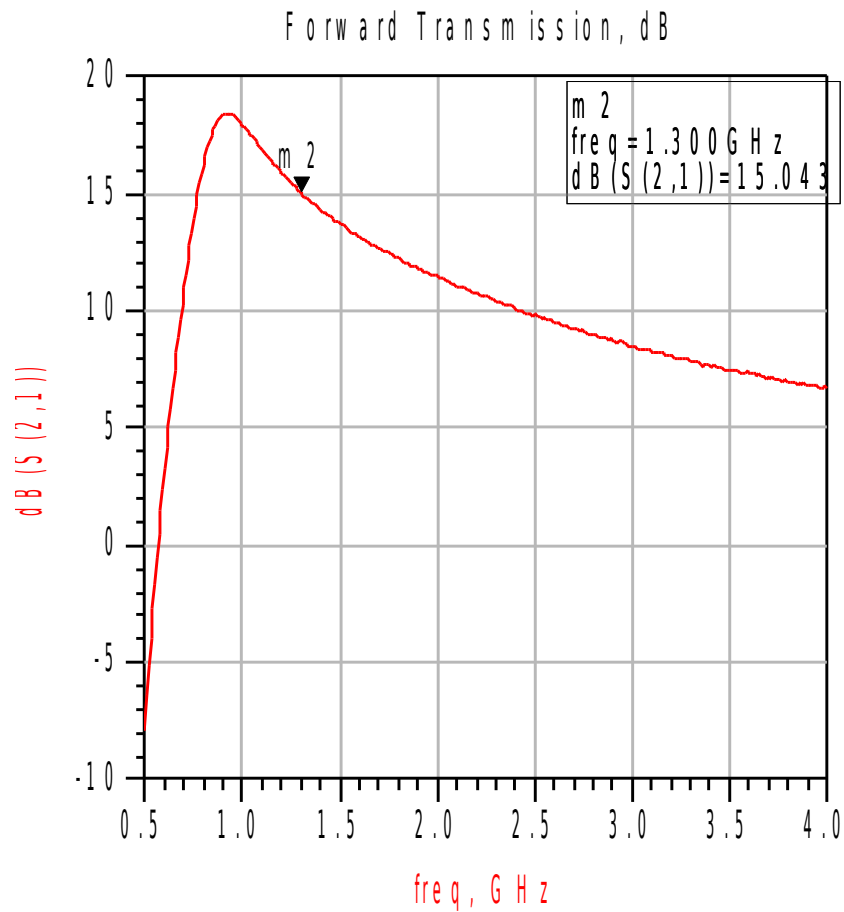
Single Stage LNA – Layout on RO4003



Measured input and output matching



Measured Gain and stability factor



Measured noise figure 0.7 dB :- (

