1GHz low voltage LNA and mixer SA611

DESCRIPTION

The SA611 is a combined low-noise amplifier, and mixer designed for high-performance low-power communication systems from 800-1000MHz. The low-noise preamplifier has a 1.7dB noise figure at 881MHz with 15dB gain and an IP3 intercept of -7dBm at the input. The gain is stabilized by on-chip compensation to vary less than ±0.2dB over -40 to +85°C temperature range. The wide-dynamic-range mixer has a 12dB noise figure and IP3 of +7.0dBm at the input at 881MHz. The nominal current drawn from a single 3V supply is 8.3mA. Additionally, the entire circuit can be powered down to further reduce the supply current to less than 20µA.

FEATURES

- Low current consumption
- Outstanding gain and noise figure
- Excellent gain stability versus temperature and supply voltage
- LNA and mixer power down capability

PIN CONFIGURATION

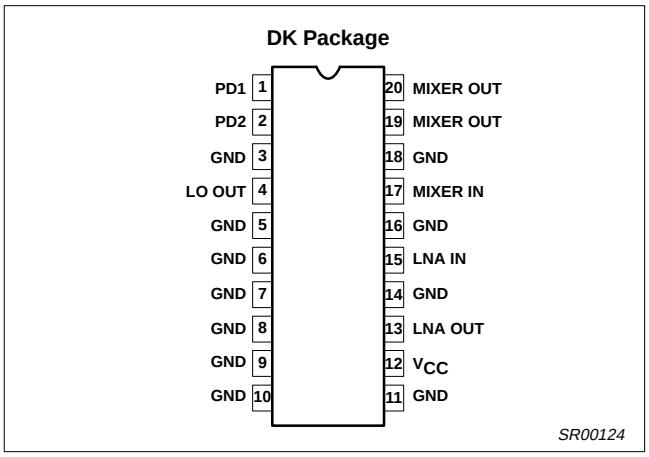


Figure 1. Pin Configuration

APPLICATIONS

- 900MHz cellular and cordless front-end
- Spread spectrum receivers
- RF data links
- UHF frequency conversion
- Portable radio

ORDERING INFORMATION

DESCRIPTION	TEMPERATURE RANGE	ORDER CODE	DWG #
20-Pin Plastic Shrink Small Outline Package (Surface-mount, SSOP)	-40 to +85°C	SA611DK	SOT266-1

BLOCK DIAGRAM

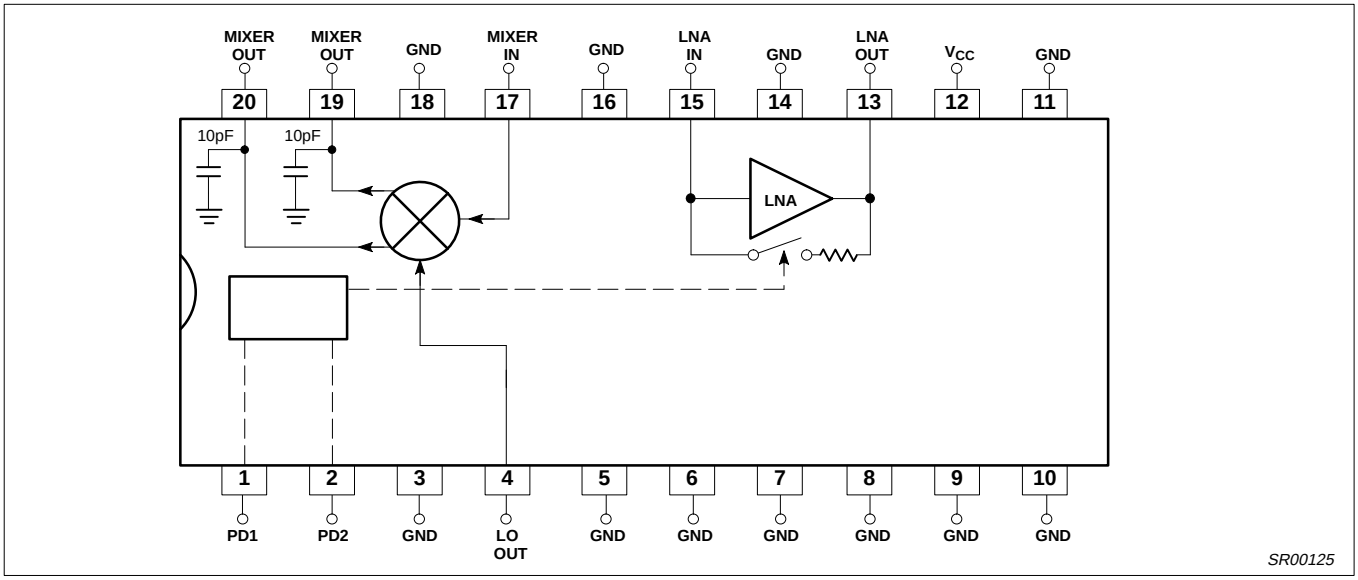


Figure 2. SA611 Block Diagram

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	RATING	UNITS
V_{CC}	Supply voltage[1]	-0.3 to +6	V
V_{IN}	Voltage applied to any other pin	-0.3 to (V_{CC} + 0.3)	V
P_D	Power dissipation, T_A = 25°C (still air)2 20-Pin Plastic SSOP	980	mW
T_{JMAX}	Maximum operating junction temperature	150	°C
P_{MAX}	Maximum power input/output	+20	dBm
T_{STG}	Storage temperature range	–65 to +150	°C

NOTE:
1. Transients exceeding 8V on V_{CC} pin may damage product.
2. Maximum dissipation is determined by the operating ambient temperature and the thermal resistance,
   θ_{JA}: 20-Pin SSOP = 110°C/W
3. Pins 19 and 20 are ESD sensitive (mixer outputs).

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	RATING	UNITS
V_{CC}	Supply voltage	2.7 to 5.5	V
T_A	Operating ambient temperature range	-40 to +85	°C
T_J	Operating junction temperature	-40 to +105	°C

DC ELECTRICAL CHARACTERISTICS

V_{CC} = +3.0V, T_A = 25°C; unless otherwise stated.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNITS
			MIN	TYP	MAX	
I_{CC}	Supply current	Full power-on		8.3		mA
		LNA powered-down		5.2		mA
		Full power-down		20		µA
V_T	PD logic threshold voltage		1.2	1.6	1.8	V
V_{IH}	Logic 1 level		2.0		V_{CC}	V
V_{IL}	Logic 0 level		–0.3		0.8	V
I_{IL}	PD1 input current	Enable = 0.4V		10		µA
I_{IH}	PD2 input current	Enable = 2.4V		10		µA

AC ELECTRICAL CHARACTERISTICS

V_{CC} = +3.0V, T_A = 25°C; RF_{IN} = 881MHz, f_{VCO} = 964MHz; unless otherwise stated.

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS			UNITS
			−3σ	TYP	+3σ	
Low Noise Amplifier						
f_{RF}	RF input frequency range		800		1000	MHz
S_{21}	Amplifier gain			15		dB
S_{21}	Amplifier gain in power-down mode			-28		dB
$\Delta S_{21}/\Delta T$	Gain temperature sensitivity enabled			0.006		dB/°C
$\Delta S_{21}/\Delta f$	Gain frequency variation	800MHz - 1.0GHz		±0.013		dB/MHz
S_{12}	Amplifier reverse isolation	@ 881 MHz		-28		dB
S_{11}	Amplifier input match	With ext. impedance matching		-10		dB
S_{22}	Amplifier output match			-10		dB
P_{-1dB}	Amplifier input 1dB gain compression			-20		dBm
IP3	Amplifier input third order intercept			-7		dBm
NF	Amplifier noise figure			1.7		dB
t_{ON}	Amplifier turn-on time (Enable Lo → Hi)			120		µs
t_{OFF}	Amplifier turn-off time (Enable Hi → Lo)			0.3		µs
Mixer						
PG_C	Mixer power conversion gain: $R_P = R_L$ = 1.2kΩ,	f_{RF} = 881MHz, f_{LO} = 964MHz, f_{IF} = 83MHz		8.7		dB
S_{11M}	Mixer input match	Ext. impedance matching req.		-10		dB
NF_M	Mixer SSB noise figure			12		dB
P_{-1dB}	Mixer input 1dB gain compression			-14.5		dBm
$IP3_M$	Mixer input third order intercept			7.0		dBm
IP_{2INT}	Mixer input second order intercept			15		dBm
P_{RFM-IF}	Mixer RF feedthrough	RF_{IN} = -28dBm		-45		dBm
P_{LO-IF}	LO feedthrough to IF	LO = -0dBm		-23		dBm
P_{LO-RFM}	LO to mixer input feedthrough			-36		dBm
P_{LO-RF}	LO to LNA input feedthrough			-38		dBm
Overall System						
G_{SYS}	System gain	LNA + Mixer	23.0	23.7	24.4	dB

Table 3. Power ON/OFF Control Logic

PD1	PD2	
0	0	Full chip power-down
0	1 or open	Mixer on, LNA power-down
1 or open	0	Standby (bias on)
1 or open	1 or open	Full chip power-on (default)

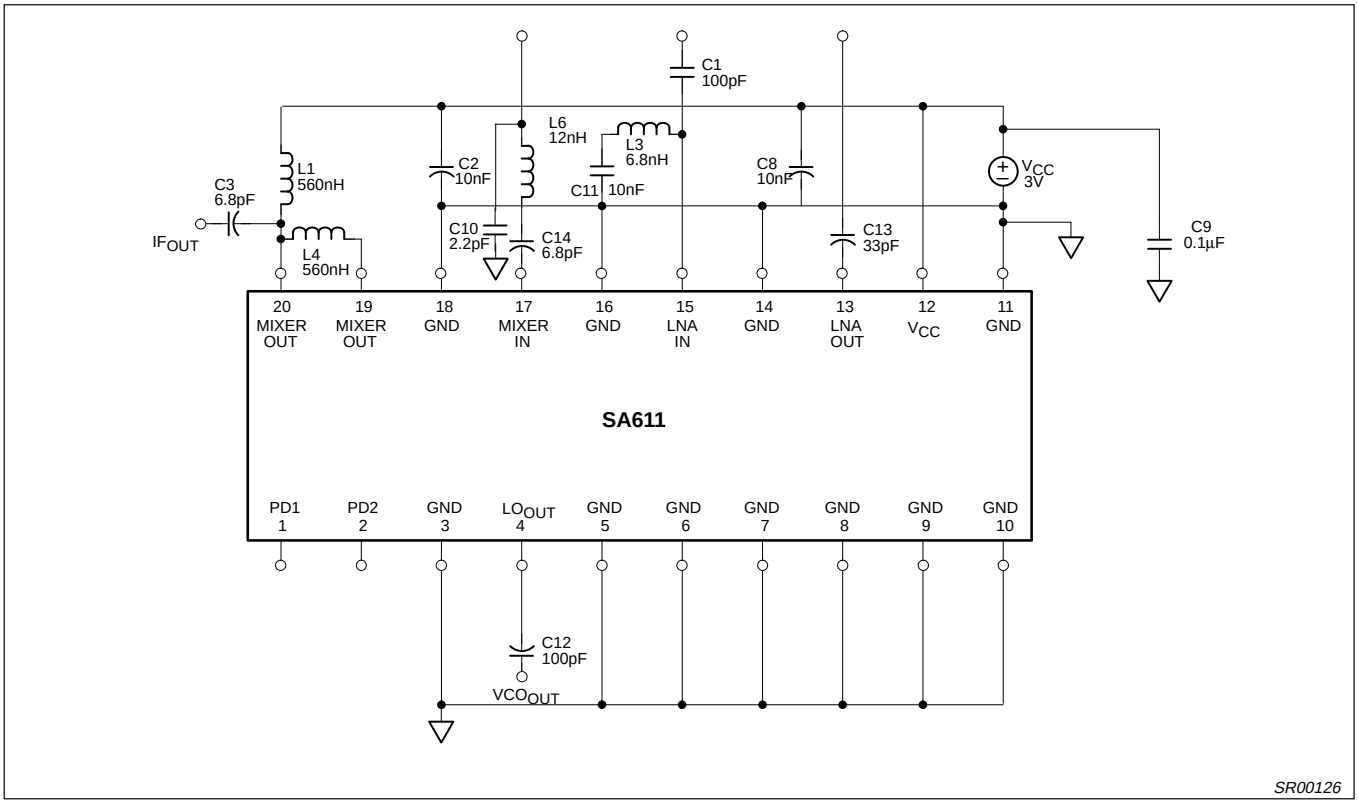
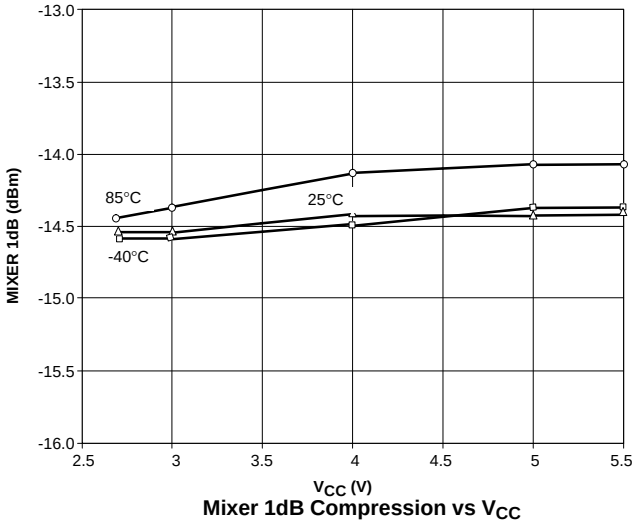
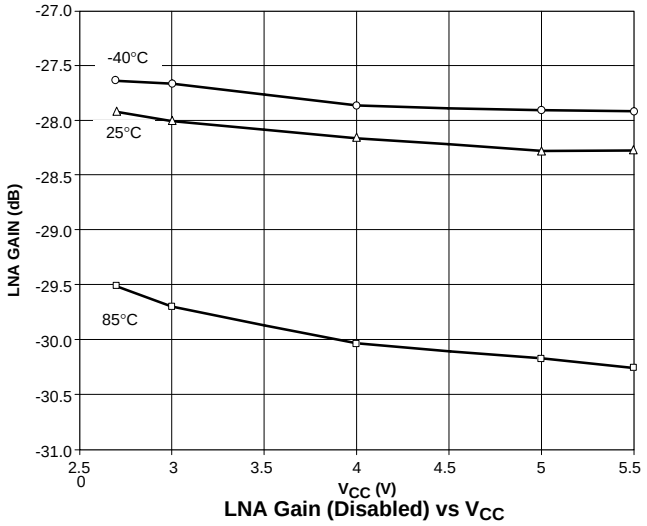


Figure 3. SA611 Applications Circuit

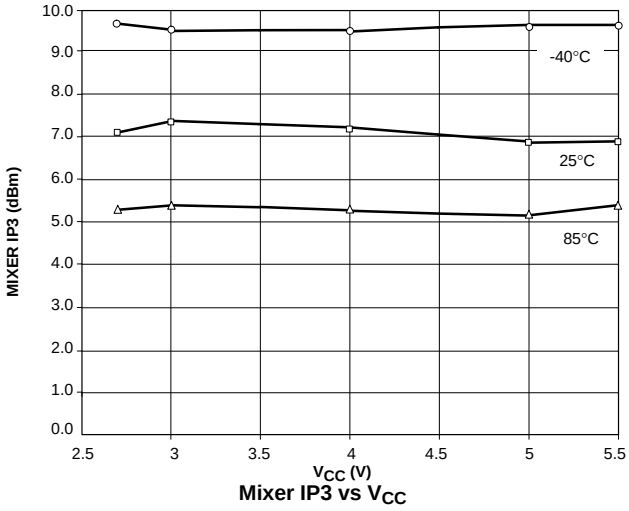
PERFORMANCE CHARACTERISTICS



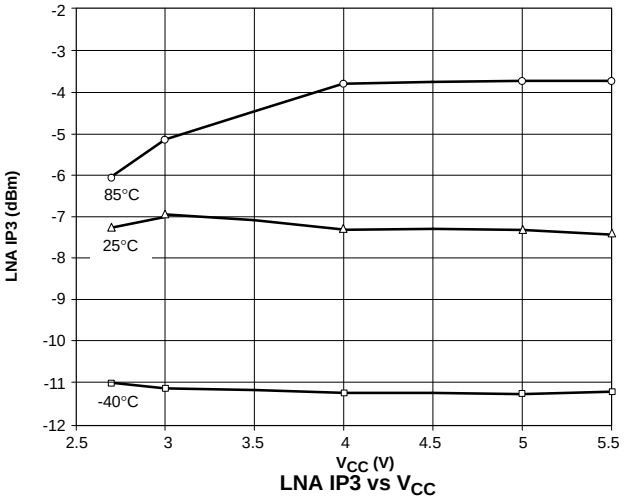
Mixer 1dB Compression vs V_{CC}



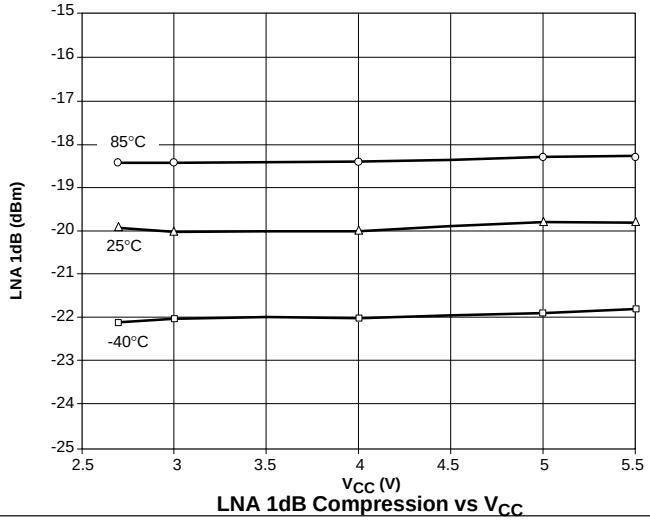
LNA Gain (Disabled) vs V_{CC}



Mixer IP3 vs V_{CC}



LNA IP3 vs V_{CC}

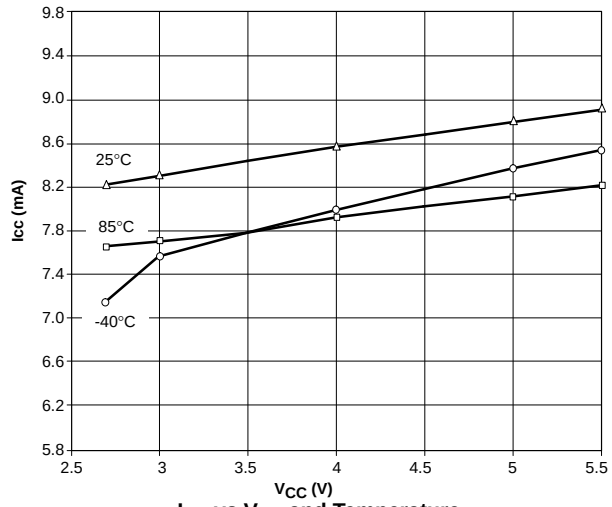


LNA 1dB Compression vs V_{CC}

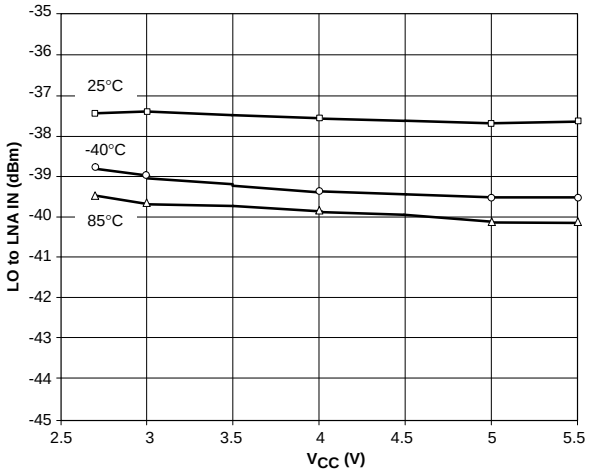
SR01249

Figure 4.

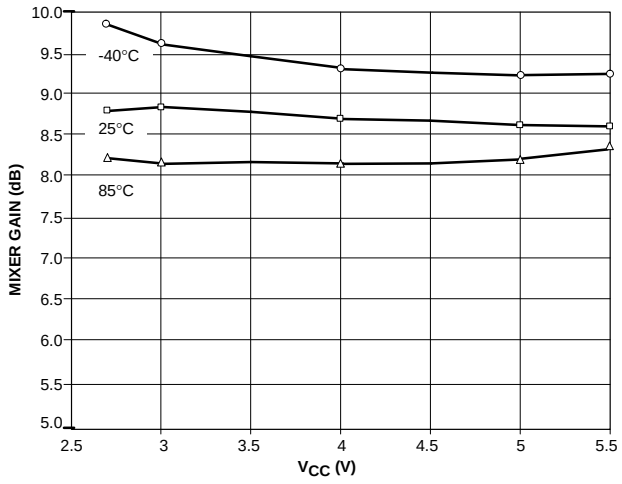
PERFORMANCE CHARACTERISTICS



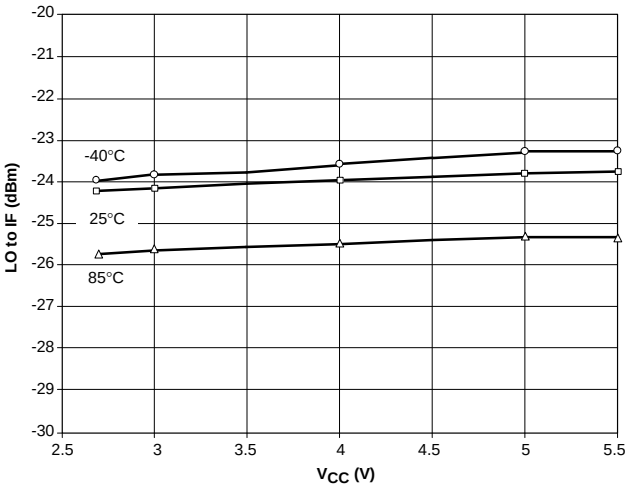
I_{CC} vs V_{CC} and Temperature



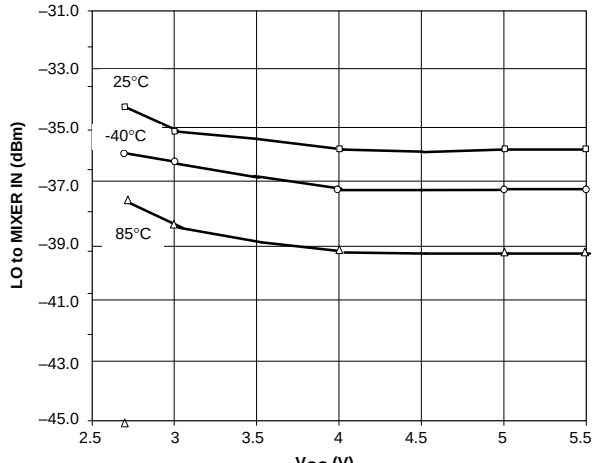
LO to LNA In Feedthrough vs V_{CC}



Mixer Power Gain vs V_{CC}



LO to IF Feedthrough vs V_{CC}



LO to Mixer In Feedthrough vs V_{CC}

SR01250

Figure 5.

PERFORMANCE CHARACTERISTICS

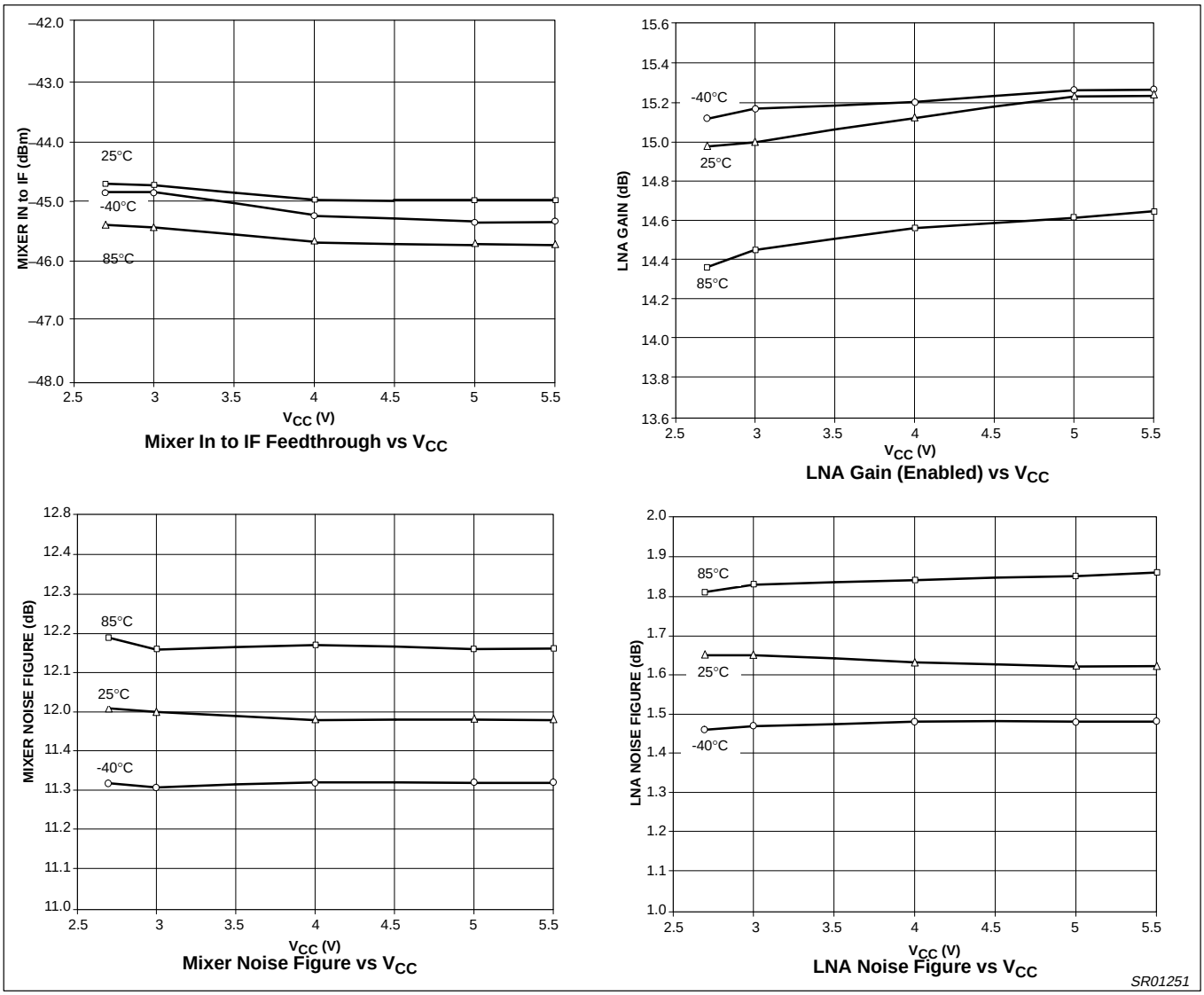


Figure 6.

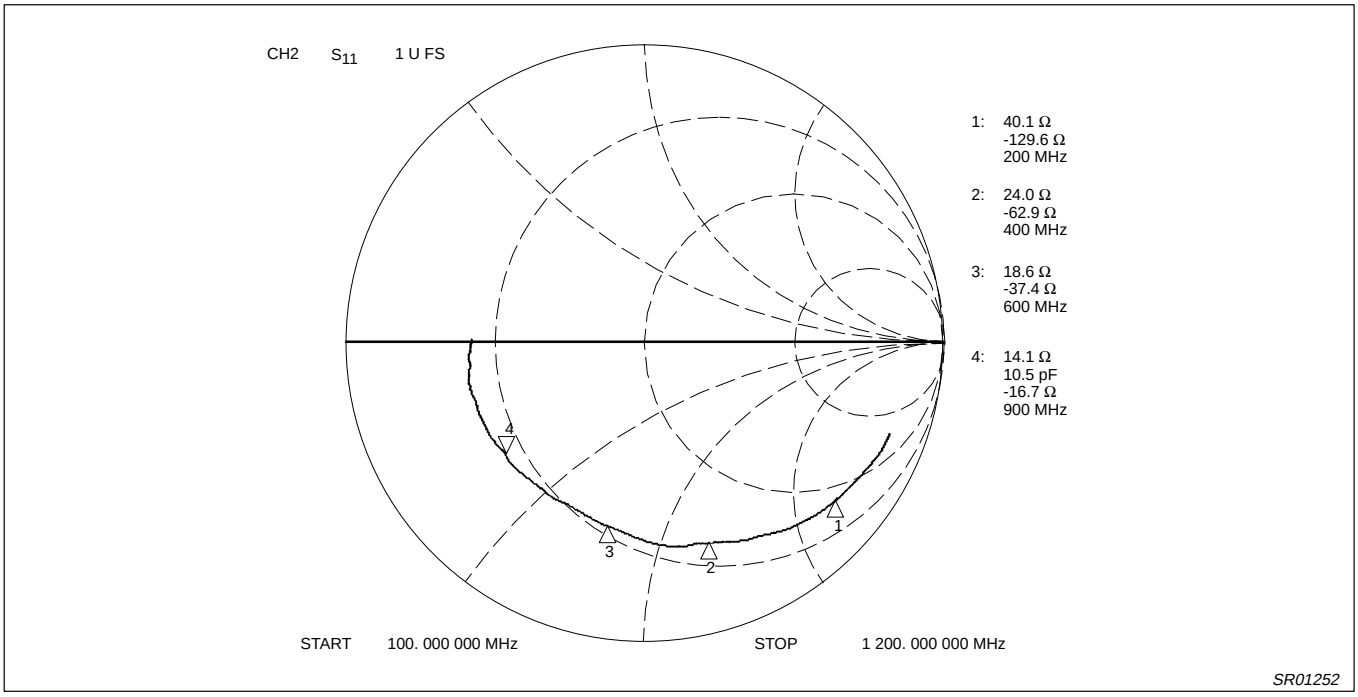


Figure 7. Typical S_{11} of LNA at 3V

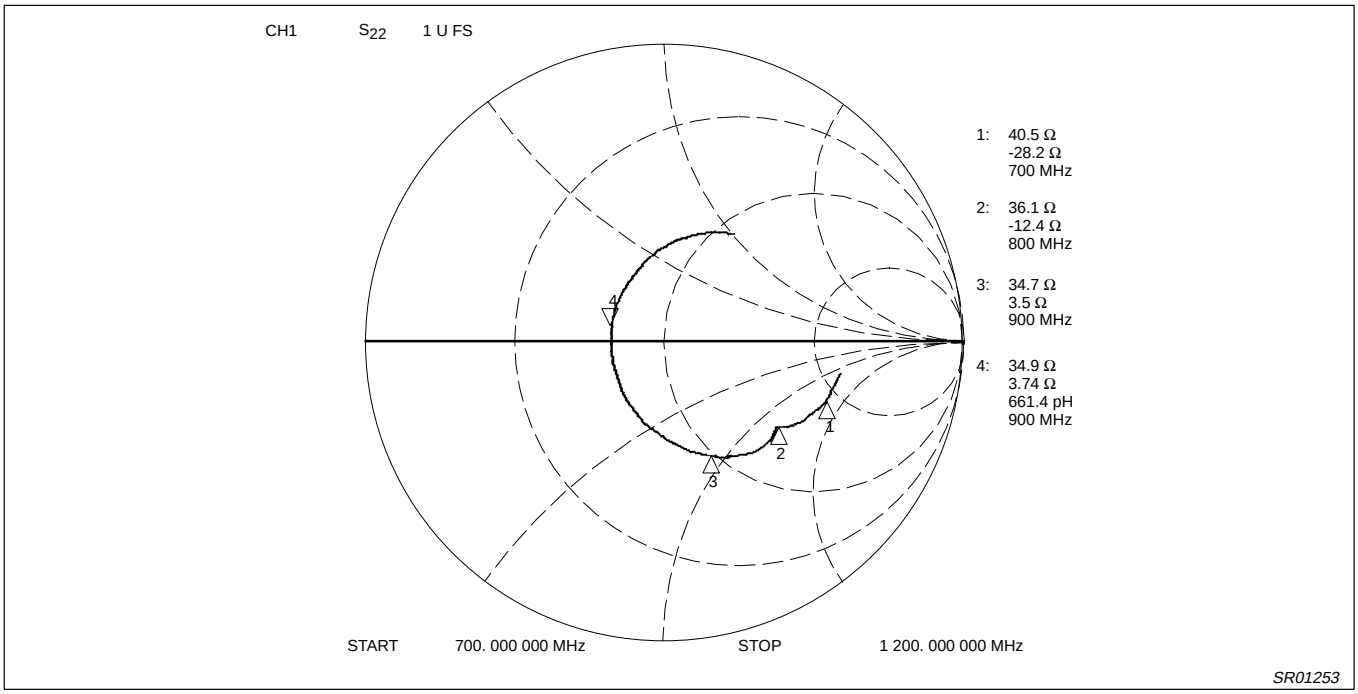


Figure 8. Typical S_{22} of LNA at 3V

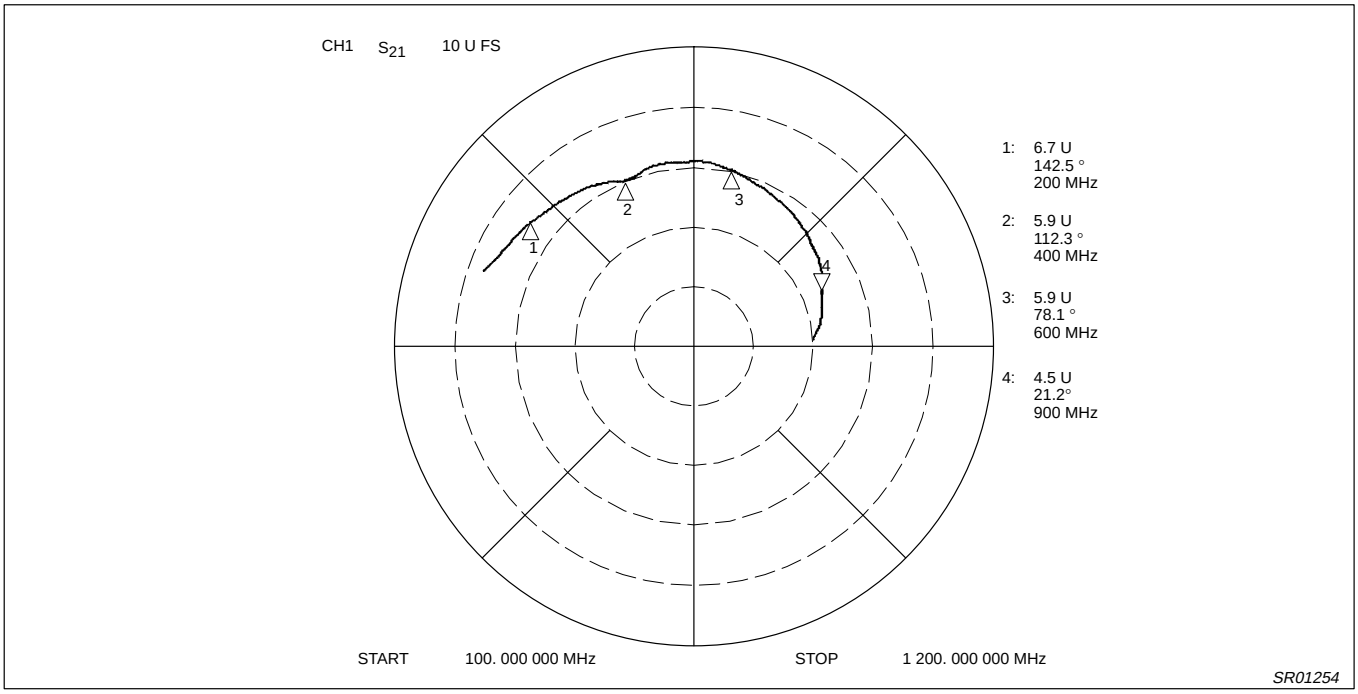


Figure 9. Typical S_{21} of LNA at 3V

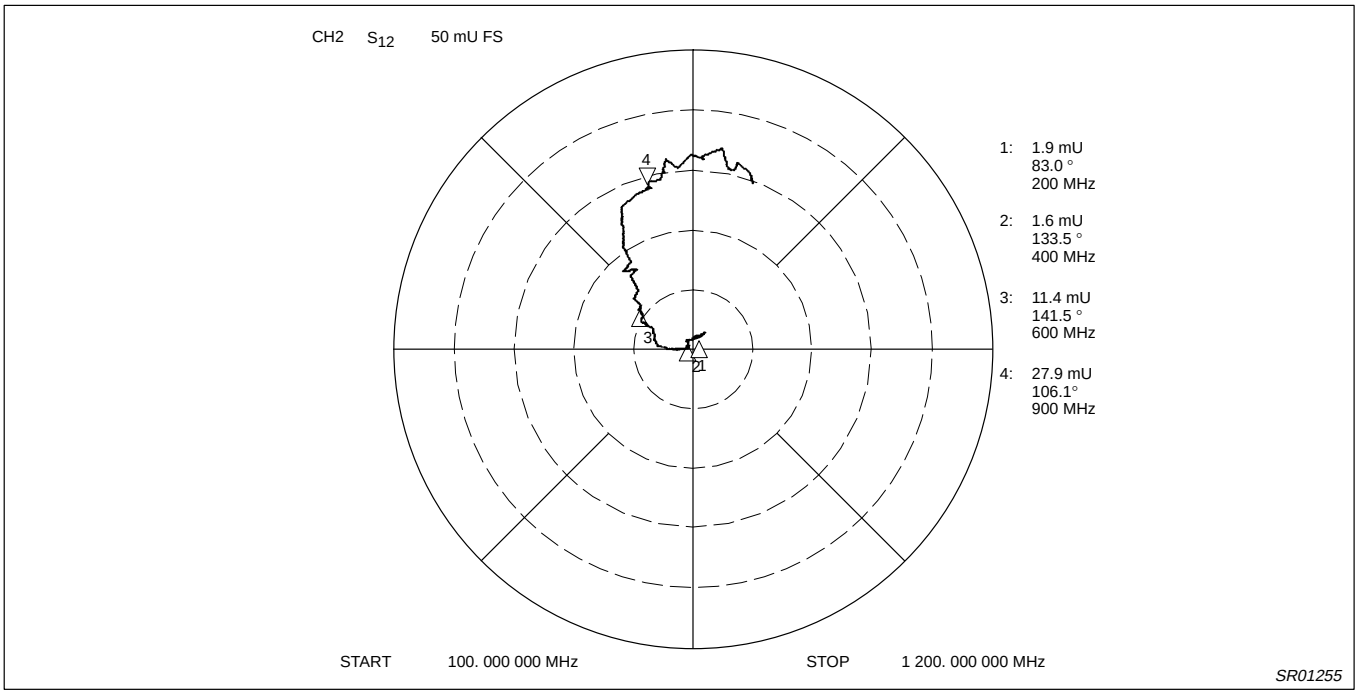


Figure 10. Typical S_{12} of LNA at 3V

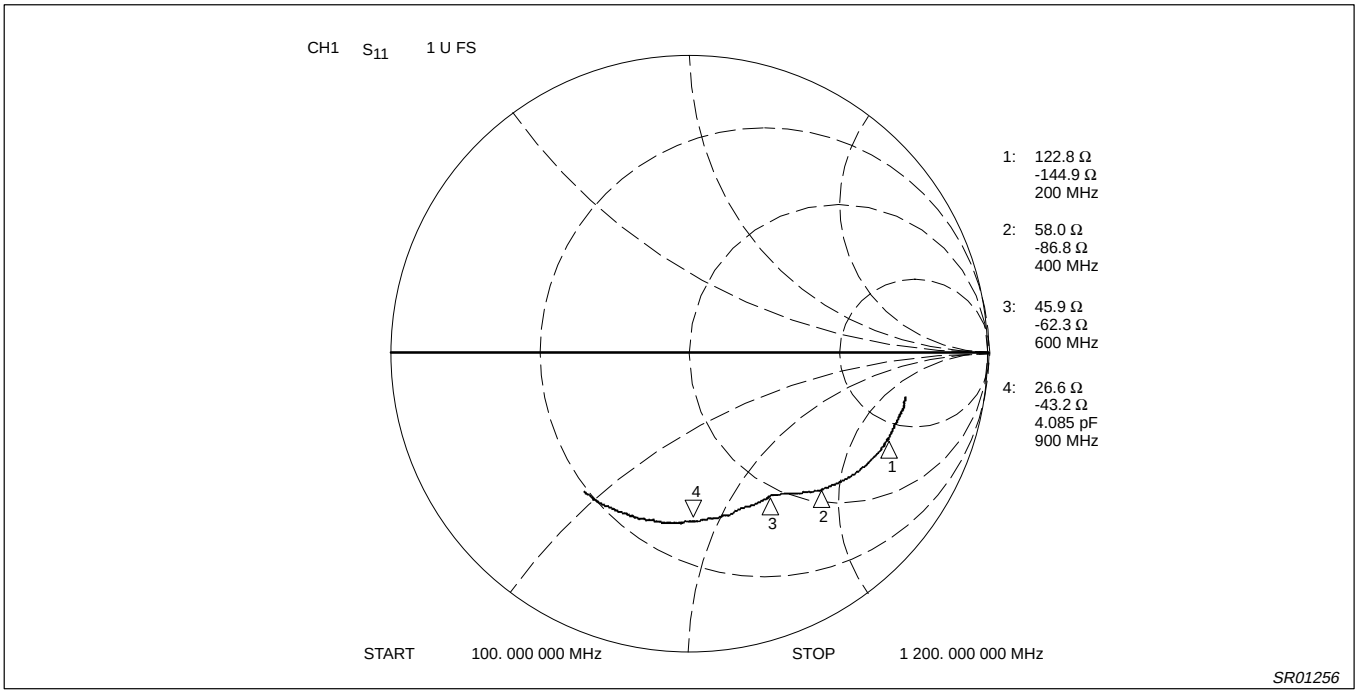


Figure 11. Typical S_{11} of Mixer at 3V

Table 4. Typical S-Parameters of LNA at 3V

LNA								
Freq (MHz)	$\|S_{11}\|$ (U)	$<S_{11}$ (deg)	$\|S_{21}\|$ (U)	$<S_{21}$ (deg)	$\|S_{12}\|$ (U)	$<S_{12}$ (deg)	$\|S_{22}\|$ (U)	$<S_{22}$ (deg)
100	0.86	-20	7.4	160	0.001	91.91	0.59	-9.62
122	0.86	-24	7.1	156	0.001	62	0.58	-11.71
144	0.85	-28	7.0	151	0.001	105.42	0.58	-13.86
166	0.83	-32	6.9	148	0.000	91.65	0.57	-15.89
188	0.82	-36	6.8	144	0.002	100.23	0.57	-17.80
210	0.81	-41	6.7	140	0.002	73.57	0.56	-20.05
232	0.80	-45	6.6	136	0.002	99.70	0.55	-22.37
254	0.79	-48	6.5	133	0.001	84.00	0.54	-24.60
276	0.78	-52	6.4	130	0.001	103.18	0.53	-26.89
298	0.76	-56	6.3	126	0.002	94.33	0.52	-28.72
320	0.75	-59	6.3	123	0.002	66.98	0.51	-30.98
342	0.73	-63	6.2	119	0.002	108.53	0.50	-32.79
364	0.71	-66	6.1	116	0.002	118.13	0.48	-34.68
386	0.70	-69	6.0	113	0.001	103.4	0.47	-36.06
408	0.69	-72	5.9	111	0.001	175.94	0.46	-36.64
430	0.68	-76	5.9	109	0.004	174.1	0.45	-37.21
452	0.69	-78	6.0	106	0.006	162.02	0.46	-38.41
474	0.68	-82	6.1	102	0.007	160.07	0.47	-41.54
496	0.67	-85	6.1	97	0.008	153.6	0.47	-45.75
518	0.66	-89	6.1	93	0.010	146.17	0.46	-50.35
540	0.65	-92	6.1	89	0.009	142.13	0.45	-54.73
562	0.63	-96	6.1	85	0.010	138.49	0.43	-59.16
584	0.62	-99	6.0	81	0.011	146.17	0.42	-63.93
606	0.62	-102	5.9	77	0.011	140.55	0.40	-68.56
628	0.61	-104	5.8	72	0.013	137.2	0.38	-73.48
650	0.61	-107	5.7	69	0.013	130.62	0.36	-78.19
672	0.60	-109	5.7	65	0.016	129.77	0.34	-83.75
694	0.60	-112	5.6	61	0.016	131.94	0.31	-89.81
716	0.59	-115	5.5	57	0.017	128.67	0.29	-96.92
738	0.59	-118	5.5	53	0.019	127.53	0.27	-104.48
760	0.59	-121	5.3	48	0.021	123.42	0.24	-112.81
782	0.59	-124	5.3	44	0.021	122.31	0.22	-122.41
804	0.59	-126	5.1	40	0.022	119.52	0.21	-132.81
826	0.59	-129	5.0	36	0.024	118.29	0.19	-145.39
848	0.59	-132	4.9	31	0.026	115.98	0.18	-159.13
870	0.59	-135	4.8	26	0.027	111.9	0.17	-175.11
892	0.59	-138	4.6	22	0.028	108.11	0.18	169.02
914	0.59	-142	4.5	18	0.028	105.92	0.19	154.96
936	0.59	-144	4.3	14	0.028	106.13	0.20	141.94
958	0.59	-148	4.2	9	0.030	99.79	0.22	130.27
980	0.59	-151	4.0	4	0.031	99.30	0.24	119.5
1002	0.59	-153	3.8	0	0.031	94.81	0.26	110.61
1024	0.59	-157	3.6	-2	0.032	90.91	0.28	102.16
1046	0.59	-160	3.5	-6	0.032	85.65	0.30	94.98
1068	0.59	-164	3.3	-10	0.033	86.10	0.33	88.45
1090	0.59	-167	3.2	-14	0.033	80.59	0.35	82.47
1112	0.59	-170	3.0	-18	0.031	79.18	0.36	77.17
1134	0.58	-172	2.8	-22	0.030	46.32	0.38	71.98
1156	0.58	-175	2.7	-25	0.031	78.57	0.39	67.45
1178	0.57	-178	2.5	-28	0.031	73.66	0.41	62.73
1200	0.57	178	2.4	-31	0.029	71.78	0.42	58.87

Table 5. Typical S-Parameters of Mixer at 3V

Mixer		
Freq (MHz)	$\|S_{11}\|$ (U)	$<S_{11}$ (deg)
100	0.73	-11
122	0.73	-147
144	0.72	-16
166	0.72	-19
188	0.72	-21
210	0.71	-24
232	0.70	-27
254	0.70	-29
276	0.69	-32
298	0.68	-34
320	0.67	-37
342	0.66	-39
364	0.64	-42
386	0.63	-–44
408	0.62	-46
430	0.61	-48
452	0.59	-50
474	0.58	-52
496	0.57	-53
518	0.56	-54
540	0.55	-56
562	0.55	-57
584	0.54	-59
606	0.54	-61
628	0.54	-62
650	0.54	-64

Mixer		
Freq (MHz)	$\|S_{11}\|$ (U)	$<S_{11}$ (deg)
672	0.54	-65
694	0.54	-67
716	0.54	-69
738	0.54	-71
760	0.54	-73
782	0.55	-76
804	0.55	-78
826	0.55	-80
848	0.55	-82
870	0.55	-85
892	0.56	-87
914	0.55	-90
936	0.56	-93
958	0.56	-96
980	0.56	-98
1002	0.56	-101
1024	0.57	-104
1046	0.57	-106
1068	0.57	-110
1090	0.57	-112
1112	0.57	-115
1134	0.57	-118
1156	0.57	-121
1178	0.57	-124
1200	0.57	-127