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MOTOROLA

MRFIC1814

1.9 GHz GaAs Downconverter

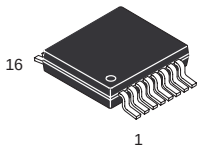
Designed primarily for use in wireless Personal Communication Systems (PCS) applications such as Digital European Cordless Telephone (DECT), Japan's Personal Handy System (PHS), and the emerging North American systems. The MRFIC1814 includes a low noise amplifier and downmixer in a low-cost TSSOP–16 package. The integrated circuit requires minimal off-chip matching while allowing for the maximum in flexibility and efficiency. The mixer is optimized for low–side injection and offers reasonable intercept point as well as high efficiency with 8.0 dB of conversion gain. Image filtering is implemented off-chip to allow maximum flexibility. CMOS compatible ENABLE pins allow standby operation where the current drain is less than 0.1 mA.

Together with the rest of the MRFIC18XX series, this GaAs IC family offers the complete transmit and receive functions, less LO and filters, needed for a typical 1.8 GHz cordless telephone.

- Usable Frequency Range = 1.8 to 2.0 GHz
- 17 dB Typ Gain, 2.5 dB Typ Noise Figure LNA
- 8.0 dB Typ Gain, 10 dB Typ Noise Figure Mixer
- –5.5 dBm Typ Mixer Input Intercept Point
- Simple LO/IF Off-chip Matching for Maximum Flexibility
- Low Power Consumption = 39 mW (Typ)
- Single Bias Supply = 2.7 to 4.5 V
- Low LO Power Requirement = –5.0 dBm (Typ)
- Low Cost Surface Mount Plastic Package

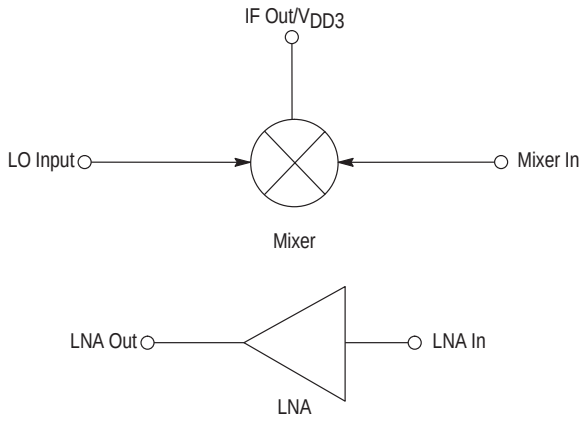
1.8 GHz LOW NOISE AMPLIFIER AND DOWNMIXER

SEMICONDUCTOR TECHNICAL DATA

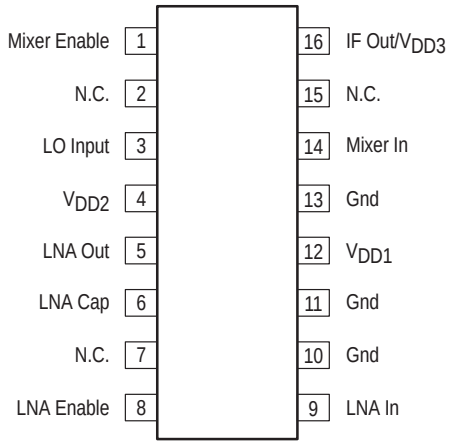


PLASTIC PACKAGE
CASE 948C
(TSSOP–16)

Functional Block Diagram



PIN CONNECTIONS



(Top View)

ORDERING INFORMATION

Device	Operating Temperature Range	Package
MRFIC1814	T_A = – 40° to +85°C	TSSOP–16
MRFIC1814R2		TSSOP–16 Tape & Reel*

*2,500 Units per 16 mm, 13 inch reel.

ARCHIVE INFORMATION

MAXIMUM RATINGS (T_A = 25°C, unless otherwise noted)

Rating	Symbol	Value	Unit
Supply Voltage	V_{DD}	5.5	Vdc
LNA Input Power	LNA_{In}	10	dBm
LO Input Power	P_{LO}	10	dBm
Enable Voltage	Enable	5.5	Vdc
Storage Temperature Range	T_{stg}	–65 to 150	°C
Operating Ambient Temperature	T_A	–30 to 85	°C

NOTES: 1. Meets Human Body Model (HBM) ≤100 V.
2. ESD data available upon request.

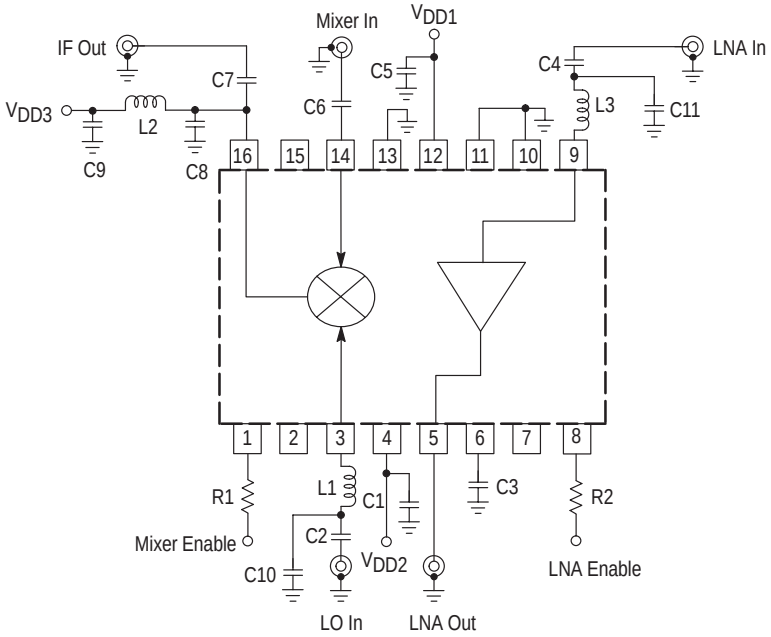
RECOMMENDED OPERATING RANGES

Parameter	Symbol	Min	Typ	Max	Unit
RF Input Frequency	f_{RF}	1.8	–	2.0	GHz
Mixer LO Frequency	f_{LO}	1.5	–	1.8	GHz
IF Output Frequency	f_{IF}	70	–	300	MHz
Supply Voltage	V_{DD}	2.7	–	4.5	Vdc
Enable Voltage, On	Mixer, LNA Enable	2.7	–	V_{DD}	Vdc
Enable Voltage, Off	Mixer, LNA Enable	0	–	0.2	Vdc

ELECTRICAL CHARACTERISTICS (V_{DD} = 3.0 V, T_A = 25°C, LO = 1.65 GHz @ –5.0 dBm, RF = 1.9 GHz @ –30 dBm, Mixer & LNA Enable = 3.0 V, unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
LNA Gain (LNA Enable = 3.0 V)	–	14	17	–	dB
LNA Gain (LNA Enable = 0 V)	–	–	–19	–	dB
LNA Noise Figure	–	–	2.5	–	dB
LNA Input 3rd Order Intercept	–	–	–7.0	–	dBm
LNA Output 1.0 dB Gain Compression Point	–	–6.0	–3.0	–	dBm
Mixer Conversion Gain (into 50 Ω)	–	5.0	8.0	–	dB
Mixer Noise Figure	–	–	10	–	dB
Mixer Input 3rd Order Intercept	–	–	–5.0	–	dBm
Mixer Output 1.0 dB Gain Compression Point	–	–8.5	–5.5	–	dBm
Total Supply Current (Enable Voltages = 3.0 V, LO Off)	–	–	10	17	mA
Total Supply Current (Enable Voltages = 3.0 V, LO On)	–	–	13	–	mA
Standby Mode Current (Enable Voltages = 0 V, LO Off)	–	–	0.05	0.25	mA

Figure 1. Applications Circuit Configuration for 250 MHz IF



C1, C2, C4	15 pF	C11	1.6 pF
C3	3.0 pF	L1	4.7 nH
C5	30 pF	L2	10 nH
C6, C8	10 pF	L3	3.9 nH
C7	12 pF	R1, R2	10 kΩ
C9	560 pF	Board Material Glass/Epoxy, ε_r = 4.45,	
C10	3.6 pF	0.018 Inch Dielectric Thickness	

Figure 2. Equivalent IF Output Circuit

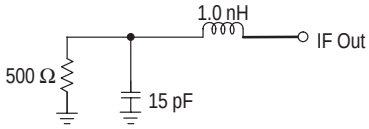


Figure 3. LNA Gain versus Frequency

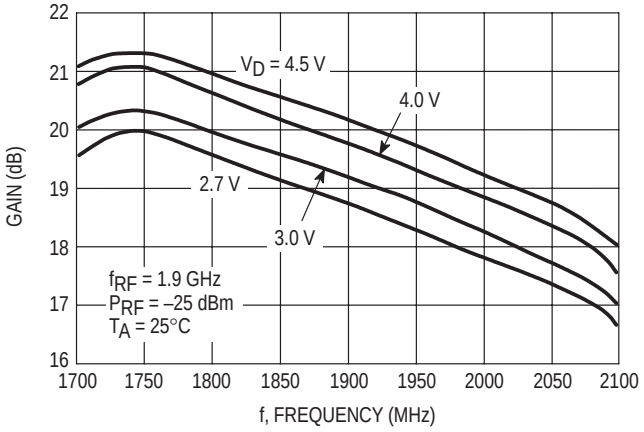


Figure 4. LNA Input 1.0 dB Compression versus Frequency

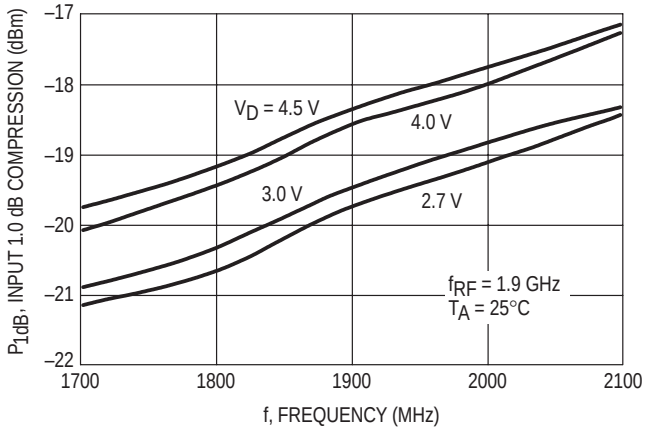


Figure 5. LNA Gain versus Frequency

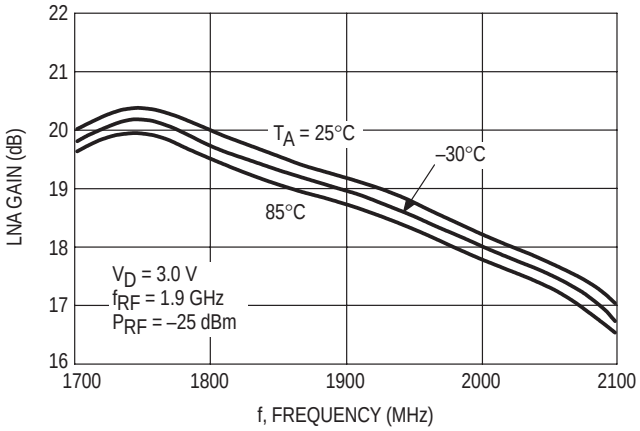


Figure 6. LNA Input 1.0 dB Compression versus Frequency

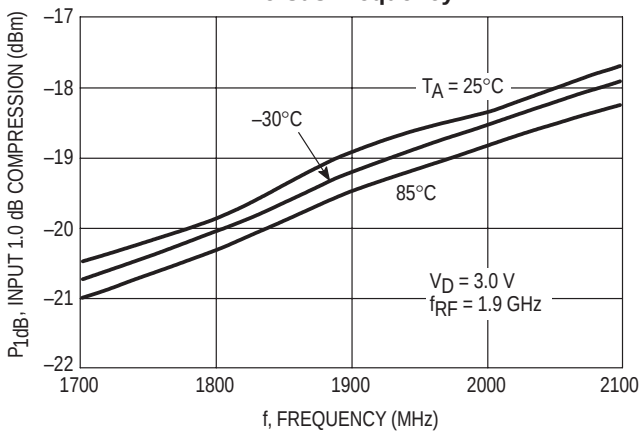


Figure 7. LNA Output Power versus Input Power

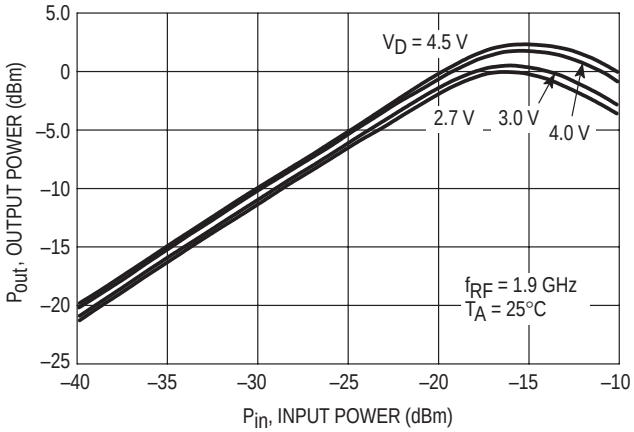


Figure 8. LNA Output Power versus Input Power

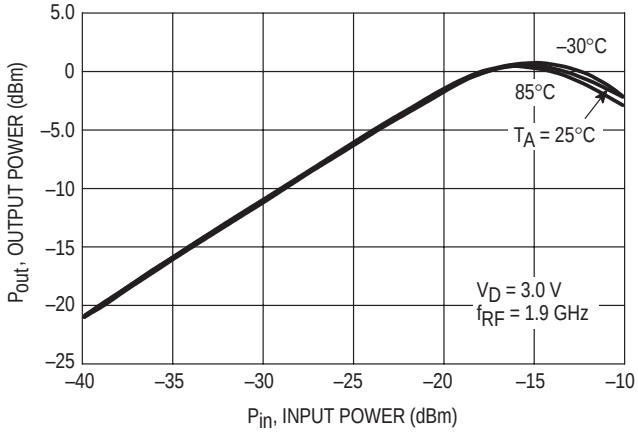


Figure 9. LNA Noise Figure versus Frequency

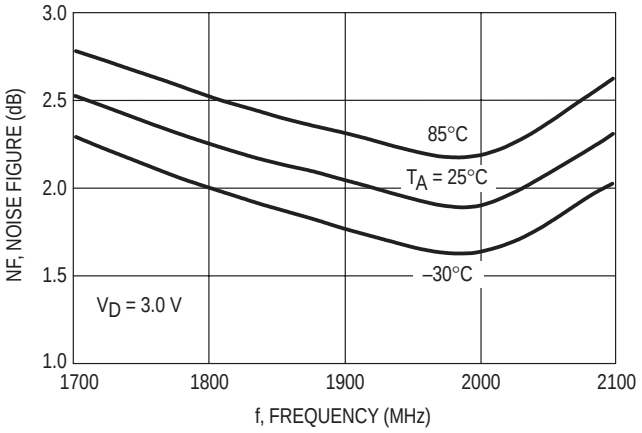


Figure 10. Mixer Noise Figure versus Frequency

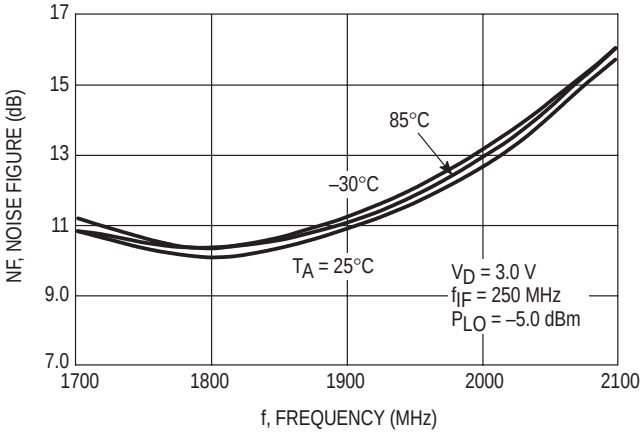


Figure 11. Mixer Noise Figure versus Frequency

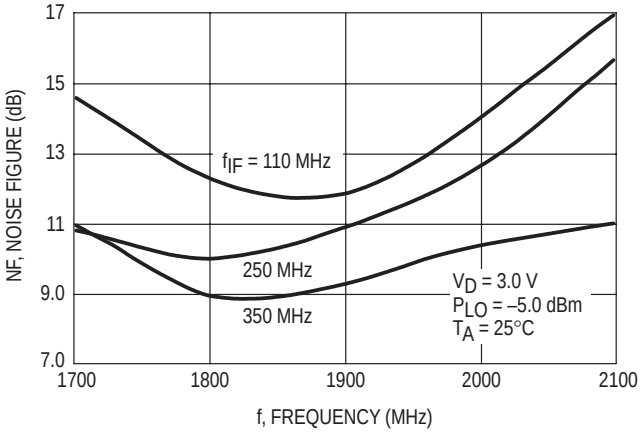


Figure 12. Mixer Conversion Gain versus LO Power

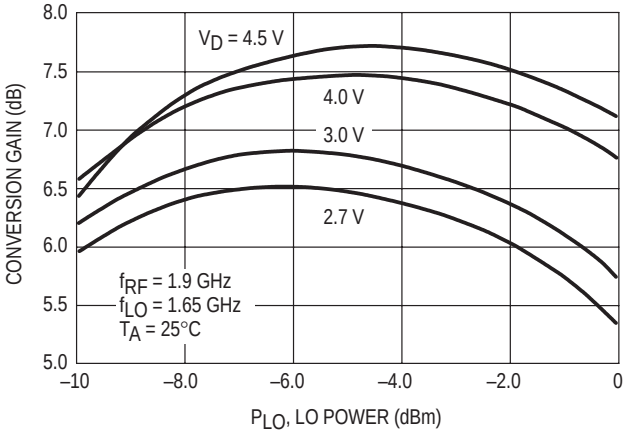


Figure 13. Mixer Conversion Gain versus LO Power

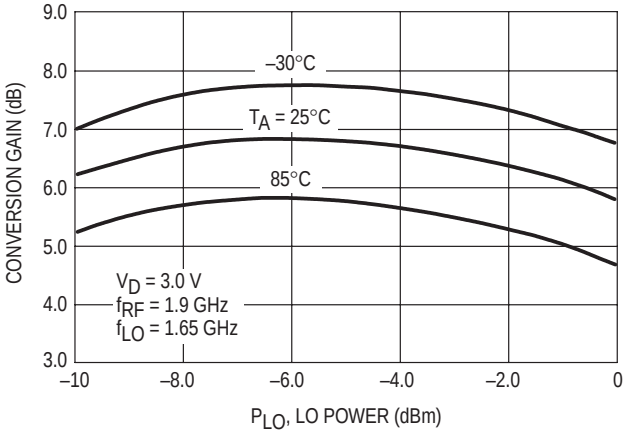


Figure 14. Mixer Conversion Gain versus Frequency

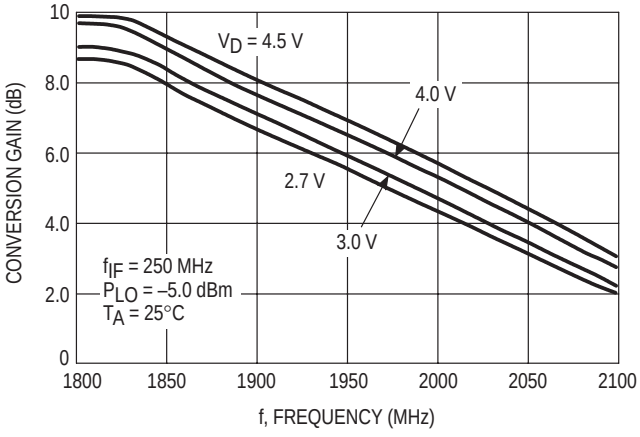


Figure 15. Mixer Conversion Gain versus Frequency

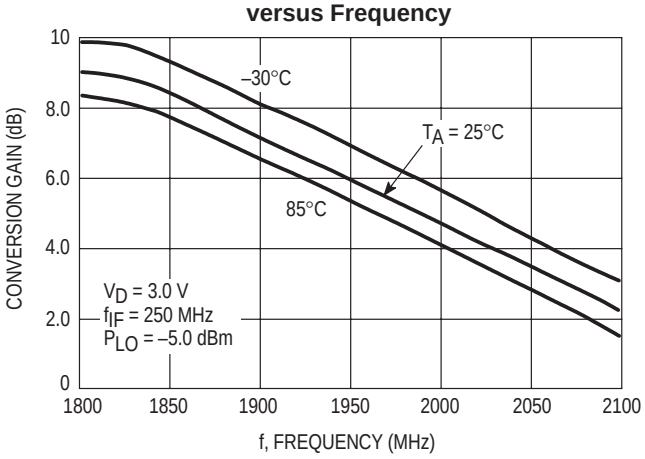


Figure 16. Mixer Conversion Gain versus Frequency

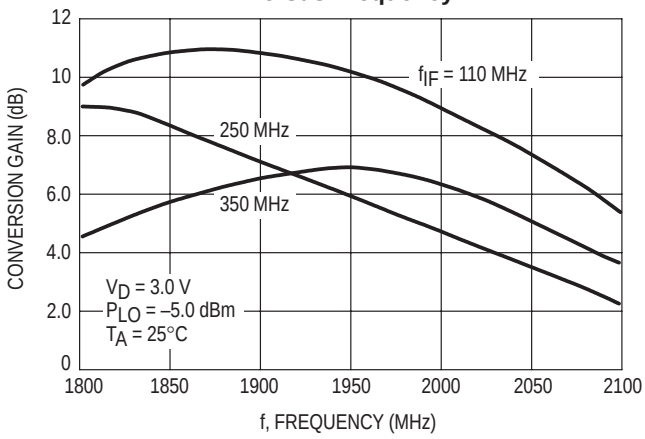


Figure 17. Mixer IF Output Power versus RF Input Power

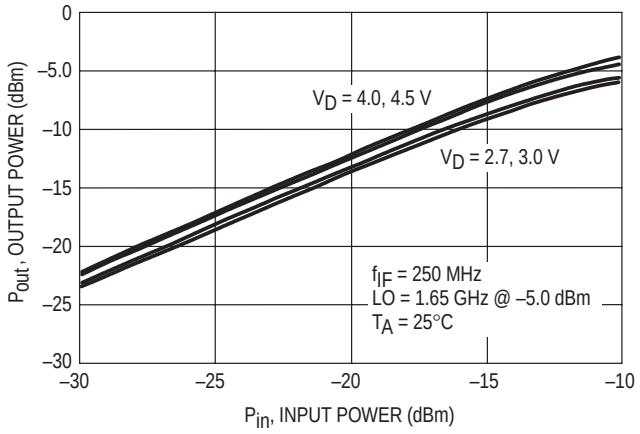


Figure 18. Mixer IF Output Power versus RF Input Power

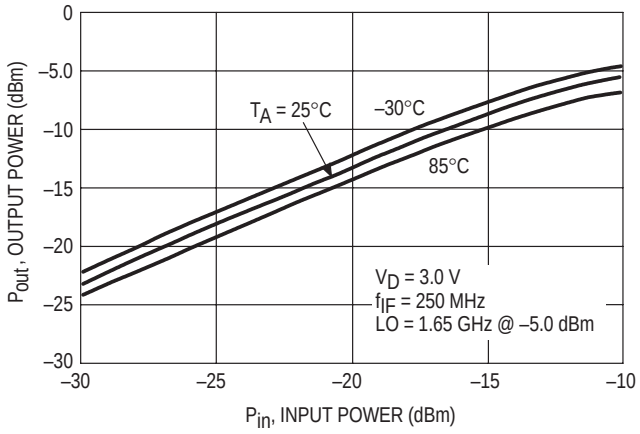


Figure 19. Mixer IF Output Power versus RF Input Power

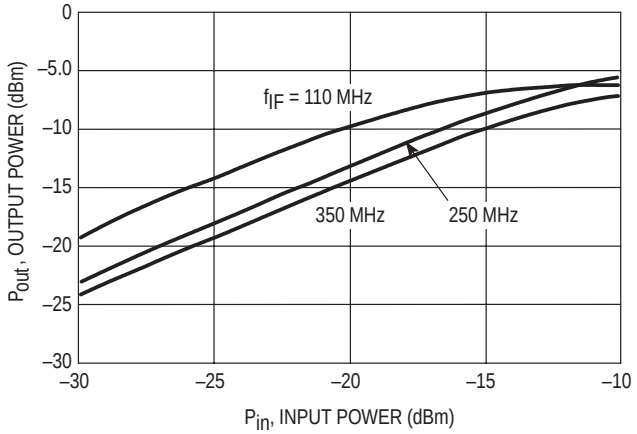


Figure 20. Total Supply Current versus Enable Voltage

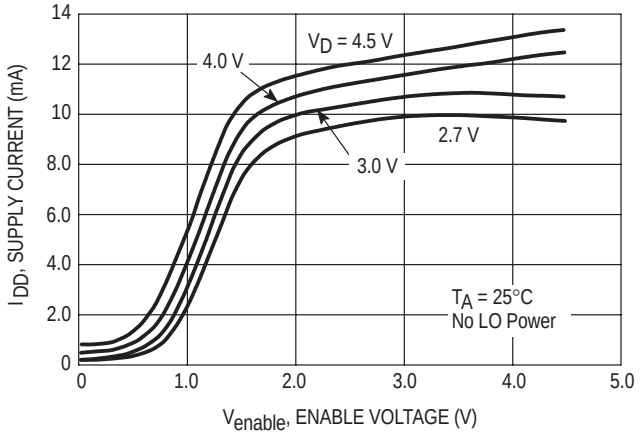


Table 1. LNA Scattering Parameters (V_{DD} = 3.0 V, T_A = 25°C, LNA Enable = 3.0 V)

f	S_{11}		S_{21}		S_{12}		S_{22}	
(MHz)	$\lvert S_{11} \rvert$	$\angle\phi$	$\lvert S_{21} \rvert$	$\angle\phi$	$\lvert S_{12} \rvert$	$\angle\phi$	$\lvert S_{22} \rvert$	$\angle\phi$
1500	0.840	–89	4.895	38.19	0.008	131.86	0.801	–55.13
1550	0.795	–92.72	5.028	29	0.009	125.54	0.779	–57.71
1600	0.734	–97.70	5.201	19.79	0.011	114.47	0.748	–60.9
1650	0.688	–101.46	5.467	12.99	0.012	106.9	0.721	–63.74
1700	0.636	–105.06	5.709	4.67	0.013	100.19	0.692	–66.43
1750	0.573	–109.56	5.903	–5.79	0.015	92.43	0.649	–70.51
1800	0.533	–113.79	6.072	–13.79	0.017	85.88	0.612	–73.59
1850	0.491	–117.18	6.214	–22.09	0.019	78.74	0.571	–77.53
1900	0.425	–121.18	6.184	–32.5	0.022	71.31	0.514	–82.96
1950	0.385	–124.25	6.273	–39.57	0.024	66.54	0.467	–86.74
2000	0.348	–128.09	6.325	–48.49	0.027	60.7	0.421	–91.62
2050	0.311	–133.47	6.131	–60.1	0.03	51.68	0.354	–98.9
2100	0.279	–139.87	5.913	–66.79	0.032	45.56	0.297	–105.36
2150	0.245	–145.18	5.830	–73.36	0.035	39.82	0.247	–112.36
2200	0.208	–150.93	5.668	–83.28	0.039	32.36	0.181	–126.37
2250	0.193	–158.52	5.466	–90.54	0.042	25	0.135	–145.26
2300	0.172	–168.94	5.208	–97.77	0.046	17.74	0.099	–174.55
2350	0.147	171.81	4.803	–105.55	0.048	9.32	0.101	136.35
2400	0.138	160.56	4.632	–111	0.05	4.19	0.136	111.97
2450	0.145	148.43	4.414	–117.57	0.054	–2.18	0.183	96.68
2500	0.165	127.94	3.989	–125.47	0.058	–13.07	0.248	81.44

Table 2. Mixer RF Port Scattering Parameters (V_{DD} = 3.0 V, T_A = 25°C, Mixer Enable = 3.0 V)

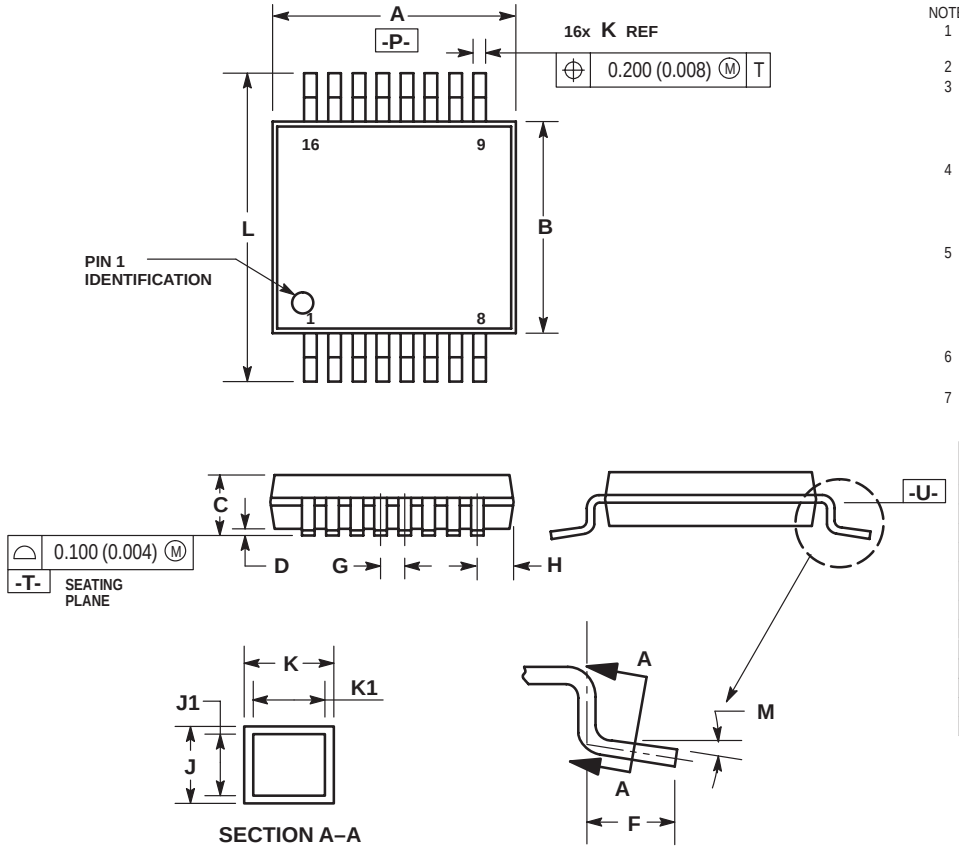
f	S_{11}		f	S_{11}		f	S_{11}	
(MHz)	$\lvert S_{11} \rvert$	$\angle\phi$	(MHz)	$\lvert S_{11} \rvert$	$\angle\phi$	(MHz)	$\lvert S_{11} \rvert$	$\angle\phi$
1500	0.294	117.08	1900	0.259	47.33	2300	0.196	–5.66
1550	0.295	110.75	1950	0.241	40.96	2350	0.192	–11.74
1600	0.296	104.68	2000	0.228	34.34	2400	0.186	–19.36
1650	0.294	96.78	2050	0.225	29.79	2450	0.177	–25.26
1700	0.297	87.62	2100	0.214	21.41	2500	0.174	–33.39
1750	0.292	75.6	2150	0.204	13.8	–	–	–
1800	0.283	65.13	2200	0.205	10.5	–	–	–
1850	0.271	55.11	2250	0.206	1.34	–	–	–

Table 3. Mixer LO Port Scattering Parameters (V_{DD} = 3.0 V, T_A = 25°C, Mixer Enable = 3.0 V)

f	S_{11}		f	S_{11}		f	S_{11}	
(MHz)	$\lvert S_{11} \rvert$	$\angle\phi$	(MHz)	$\lvert S_{11} \rvert$	$\angle\phi$	(MHz)	$\lvert S_{11} \rvert$	$\angle\phi$
1500	0.281	–85.60	1900	0.149	–103.02	2300	0.089	161.65
1550	0.265	–87.18	1950	0.134	–108.65	2350	0.108	148.38
1600	0.243	–89.74	2000	0.123	–115.69	2400	0.124	142.34
1650	0.235	–91.48	2050	0.114	–125.16	2450	0.139	137.15
1700	0.221	–93.04	2100	0.102	–132.09	2500	0.155	131.10
1750	0.205	–94.56	2150	0.094	–143.46	–	–	–
1800	0.186	–96.12	2200	0.082	–161.69	–	–	–
1850	0.171	–98.21	2250	0.081	177.29	–	–	–

OUTLINE DIMENSIONS

PLASTIC PACKAGE
CASE 948C–03
(TSSOP–16)
ISSUE B



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE –U–.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	—	5.10	—	0.200
B	4.30	4.50	0.169	0.177
C	—	1.20	—	0047
D	0.05	0.25	0.002	0.010
F	0.45	0.55	0.018	0.022
G	0.65 BSC		0.026 BSC	
H	0.22	0.23	0.009	0.010
J	0.09	0.24	0.004	0.009
J1	0.09	0.18	0.004	0.007
K	0.16	0.32	0.006	0.013
K1	0.16	0.26	0.006	0.010
L	6.30	6.50	0.248	0.256
M	0°	10°	0°	10°

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