

1GHz low voltage LNA, mixer and VCO

SA621

DESCRIPTION

The SA621 is a combined low-noise amplifier, mixer and VCO designed for high-performance low-power communication systems from 800-1000MHz. The low-noise preamplifier has a 1.9dB noise figure at 870MHz with 15dB gain and an IP3 intercept of -5dBm at the input. The gain is stabilized by on-chip compensation to vary less than ± 0.2 dB over -40 to +85°C temperature range. The wide-dynamic-range mixer has an 9.5dB noise figure and IP3 of +4dBm at the input at 870MHz. The integrated VCO circuit with external resonator produces a high quality LO signal that drives the mixer and is buffered to an external PLL synthesizer IC. The nominal current drawn from a single 3V supply is 12mA. Additionally, the entire circuit can be powered down to further reduce the supply current to less than 100µA.

FEATURES

- Low current consumption: 12mA nominal
- Outstanding gain and noise figure: 15dB gain and 1.9dB NF for the amplifier; 7dB gain and 9.5dB NF for the mixer at 870MHz
- Excellent gain stability versus temperature and supply voltage
- LNA, mixer and VCO power down capability
- Monotonic VCO frequency vs control voltage

PIN CONFIGURATION

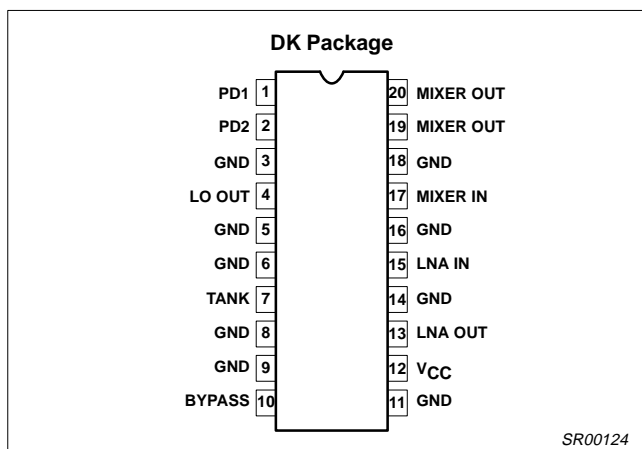


Figure 1. Pin Configuration

APPLICATIONS

- 900MHz cellular front-end
- 900MHz 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 | SA621DK | SOT266-1 |

BLOCK DIAGRAM

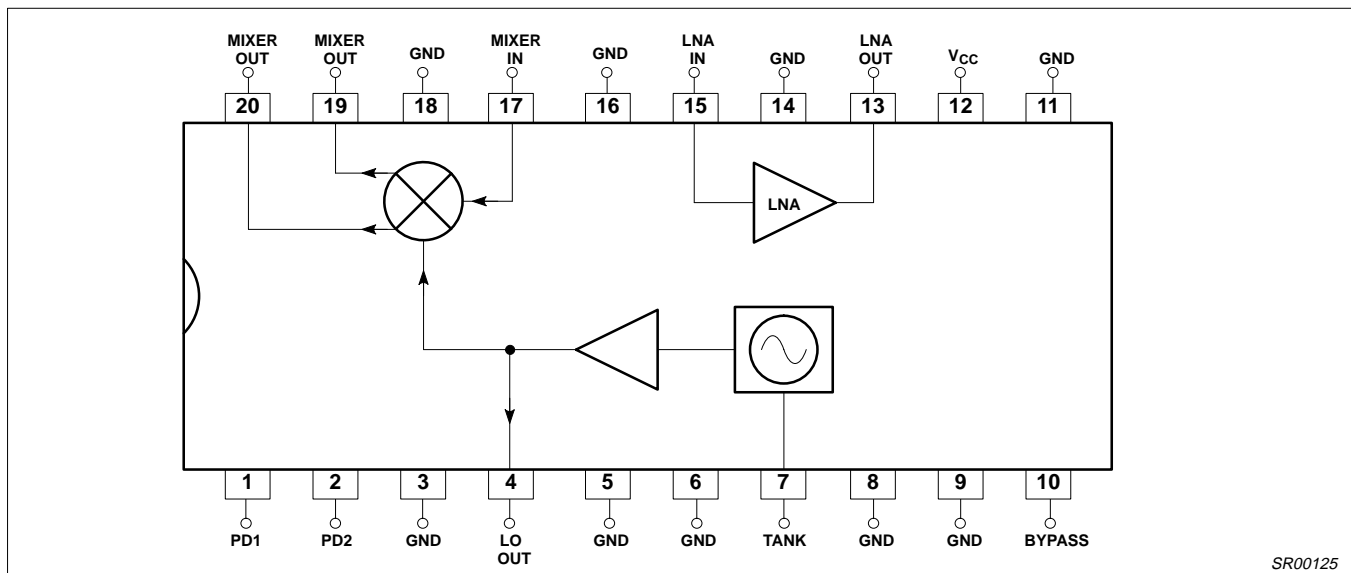


Figure 2. SA621 Block Diagram

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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, $T_A = 25^\circ\text{C}$ (still air) ² 20-Pin Plastic SSOP | 980 | mW |
| T_{JMAX} | Maximum operating junction temperature | 150 | $^\circ\text{C}$ |
| P_{MAX} | Maximum power input/output | +20 | dBm |
| T_{STG} | Storage temperature range | -65 to +150 | $^\circ\text{C}$ |

NOTE:

- Transients exceeding 8V on V_{CC} pin may damage product.
- Maximum dissipation is determined by the operating ambient temperature and the thermal resistance,
 θ_{JA} : 20-Pin SSOP = 110°C/W

RECOMMENDED OPERATING CONDITIONS

| SYMBOL | PARAMETER | RATING | UNITS |
|----------|-------------------------------------|-------------|------------------|
| V_{CC} | Supply voltage | 3.0 to 5.5 | V |
| T_A | Operating ambient temperature range | -40 to +85 | $^\circ\text{C}$ |
| T_J | Operating junction temperature | -40 to +105 | $^\circ\text{C}$ |

DC ELECTRICAL CHARACTERISTICS

 $V_{CC} = +3.3\text{V}$, $T_A = 25^\circ\text{C}$; unless otherwise stated.

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | UNITS |
|----------|--------------------------------|----------------------|--------|-----|----------|---------------|
| | | | MIN | TYP | MAX | |
| I_{CC} | Supply current | Full power-on | | 12 | | mA |
| | | LNA powered-down | | 9.3 | | mA |
| | | Standby (VCO + bias) | | 5.7 | | mA |
| | | Full power-down | | 100 | | μA |
| V_T | Enable logic threshold voltage | | 1.2 | 1.5 | 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} | Enable input current | Enable = 0.4V | -1 | 0 | 1 | μA |
| I_{IH} | Enable input current | Enable = 2.4V | -1 | 0 | 1 | μA |

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AC ELECTRICAL CHARACTERISTICS

 $V_{CC} = +3.3V$, $T_A = 25^{\circ}C$; $R_{FIN} = 870MHz$, $f_{VCO} = 915MHz$; unless otherwise stated.

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | UNITS |
|--|---|---|--------|------------|------|-----------------|
| | | | MIN | TYP | MAX | |
| Low Noise Amplifier | | | | | | |
| f_{RF} | RF input frequency range | | 800 | | 1000 | MHz |
| S_{21} | Amplifier gain | | | 15.0 | | dB |
| S_{21} | Amplifier gain in power-down mode | | | -30 | | dB |
| $\Delta S_{21}/\Delta T$ | Gain temperature sensitivity in pwr-dwn mode | | | -0.014 | | dB/ $^{\circ}C$ |
| $\Delta S_{21}/\Delta T$ | Gain temperature sensitivity enabled | | | 0.003 | | dB/ $^{\circ}C$ |
| $\Delta S_{21}/\Delta f$ | Gain frequency variation | 800MHz - 1.0GHz | | ± 0.01 | | dB/MHz |
| S_{12} | Amplifier reverse isolation | | | -22 | | dB |
| S_{11} | Amplifier input match | | | -10 | | dB |
| S_{22} | Amplifier output match | | | -10 | | dB |
| P_{-1dB} | Amplifier input 1dB gain compression | | | -16 | | dBm |
| IP3 | Amplifier input third order intercept | | | -5 | | dBm |
| NF | Amplifier noise figure | | | 1.9 | | dB |
| t_{ON} | Amplifier turn-on time (Enable Lo \rightarrow Hi) | | | 20 | | μs |
| t_{OFF} | Amplifier turn-off time (Enable Hi \rightarrow Lo) | | | 5 | | μs |
| Mixer | | | | | | |
| V_{GC} | Mixer voltage conversion gain: $R_P = R_L = 1k\Omega$, | $f_{RF} = 870MHz$, $f_{LO} = 915MHz$, $f_{IF} = 45MHz$ | | 20.0 | | dB |
| P_{GC} | Mixer power conversion gain: $R_P = R_L = 1k\Omega$, | $f_{RF} = 870MHz$, $f_{LO} = 915MHz$, $f_{IF} = 45MHz$ | | 7.0 | | dB |
| S_{11M} | Mixer input match | | | -10 | | dB |
| NF_M | Mixer SSB noise figure | | | 9.5 | | dB |
| P_{-1dB} | Mixer input 1dB gain compression | | | -9 | | dBm |
| IP3 _M | Mixer input third order intercept | | | 4 | | dBm |
| IP2 _{INT} | Mixer input second order intercept | | | 12 | | dBm |
| P_{RFM-IF} | Mixer RF feedthrough | | | -20 | | dB |
| P_{LO-IF} | LO feedthrough to IF | | | -25 | | dBm |
| P_{LO-RFM} | LO to mixer input feedthrough | | | -30 | | dBm |
| P_{LO-RF} | LO to LNA input feedthrough | | | -45 | | dBm |
| Voltage Controlled Oscillator (VCO) | | | | | | |
| f_{VCO} | VCO frequency range | | 845 | | 1045 | MHz |
| P_{VCO} | VCO power out | Pin 4 | -5 | | | dBm |
| Z_{OUT} | Output impedance | Pin 4 | | 200 | | Ω |
| | VCO phase noise | Offset = 25kHz | | -105 | | dBc/Hz |
| | | Offset = 60kHz | | -111 | | |
| | | Offset = 45MHz | | -155 | | |
| | Harmonic content | | | | -20 | dBc |
| | Residual modulation | | | | 45 | dB |
| | Modulation sensitivity | | | 18 | | MHz/V |

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AC ELECTRICAL CHARACTERISTICS (continued)

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | UNITS |
|--|-----------------------|----------------------|--------|-----|------|-------|
| | | | MIN | TYP | MAX | |
| Voltage Controlled Oscillator (VCO) cont. | | | | | | |
| | Modulation linearity | | ±20 | | | % |
| | Control voltage range | | 0.6 | | 3.0 | V |
| | Pulling figure | VSWR=2:1, all phases | | | ±1 | MHz |
| | Pushing figure | | | | ±100 | kHz/V |
| | Temperature stability | -30 to +85°C | | | ±2 | MHz |
| t _{ON/OFF} | Turn on/off time | | | | 20 | µs |

Table 6. Power ON/OFF Control Logic

| PD1 | PD2 | |
|-----------|-----------|----------------------------------|
| 0 | 0 | Full chip power-down |
| 0 | 1 or open | VCO, Mixer on, LNA power-down |
| 1 or open | 0 | VCO on, LNA and Mixer power-down |
| 1 or open | 1 or open | Full chip power-on (default) |

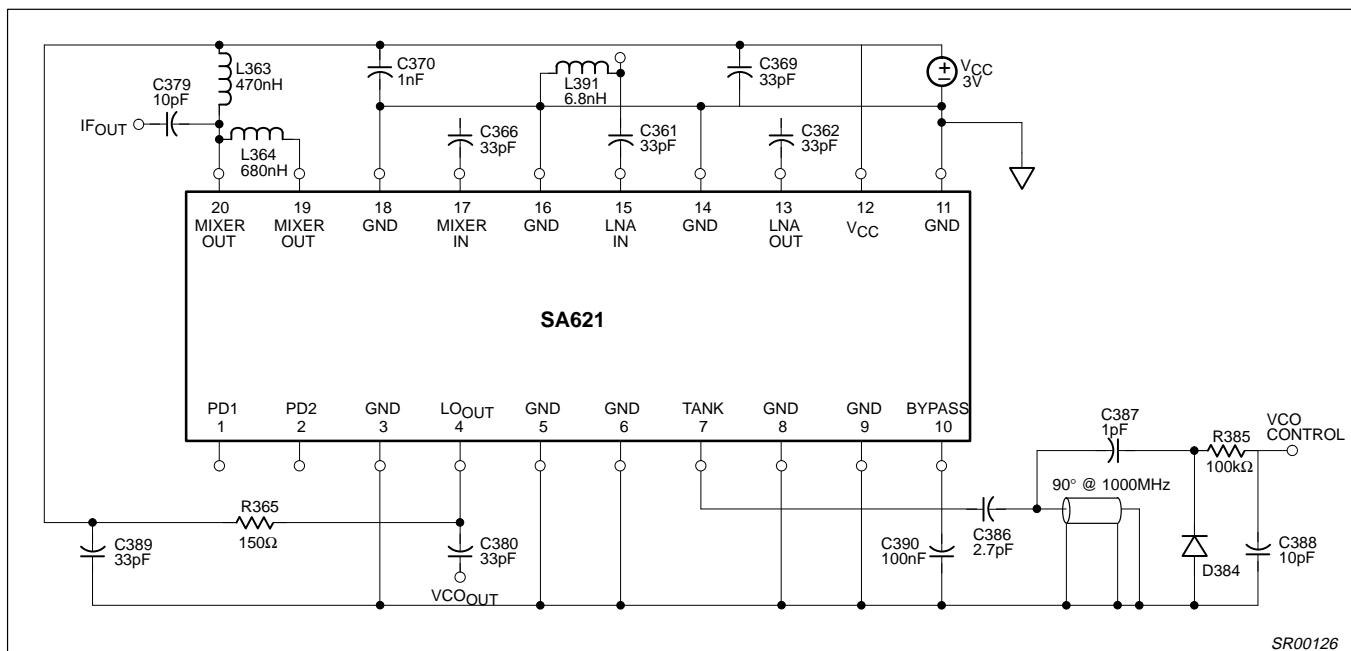


Figure 3. SA621 Applications Circuit

SR00126