

DATA SHEET

SA9500

Dual-band, CDMA/AMPS
downconverter IC

Product specification
Supersedes data of 1998 Jul 07
IC17 Data Handbook

1998 Aug 11

Dual-band, CDMA/AMPS downconverter IC

SA9500

DESCRIPTION

The SA9500 integrates all the front end receive mixers necessary for use in dual-band, triple-mode CDMA/AMPS cellular phone handsets. There are three individual mixer blocks, each optimised for high linearity with low power consumption for operation in one of the following modes: High-band 1900MHz PCS CDMA, low-band 800MHz cellular CDMA or analog FM AMPS/TACS modes. Additionally, the entire circuit can be powered down and put into sleep mode, reducing the supply current to less than 20µA. The circuit has been designed in our advanced QUBiC2 BiCMOS process with 20GHz f_T .

FEATURES

- PCS and cellular downconverter mixers typical performance:
 - PCS: Gain=11.3dB, NF=8.3dB, IIP3= +1.4dBm
 - CDMA: Gain=10.7dB, NF=9.6dB, IIP3= +6.3dBm
 - FM: Gain= 7.2dB, NF=10.2dB, IIP3= +5.9dBm
- Separate, selectable IF outputs to suit FM and CDMA bandwidths
- Integrated frequency doubler for PCS mixer LO

- Programmable wideband LO output buffer
- Low voltage operation down to 2.7V
- Low current consumption in "idle"/receive modes:
 - PCS : 20.0mA @ 2.7V
 - CDMA: 20.2mA @ 2.7V
 - FM: 7.7mA @ 2.7V
- Low standby current in sleep mode <20µA
- TSSOP20 package

APPLICATIONS

- 800MHz analog FM and CDMA digital receivers
- 1900MHz PCS band CDMA digital receivers
- Supports dual-mode and triple-mode operation
- Digital mobile communications equipment
- Portable, low power radio equipment

ORDERING INFORMATION

| EXTENDED TYPE NUMBER | PACKAGE | | | |
|-------------------------|---------|--------------|--|----------|
| | PINS | PIN POSITION | MATERIAL | CODE |
| SA9500DH | 20 | TSSOP | Plastic thin shrink small outline package; body 6.5 x 4.4 x 1.1 mm | SOT360-1 |

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BLOCK DIAGRAM

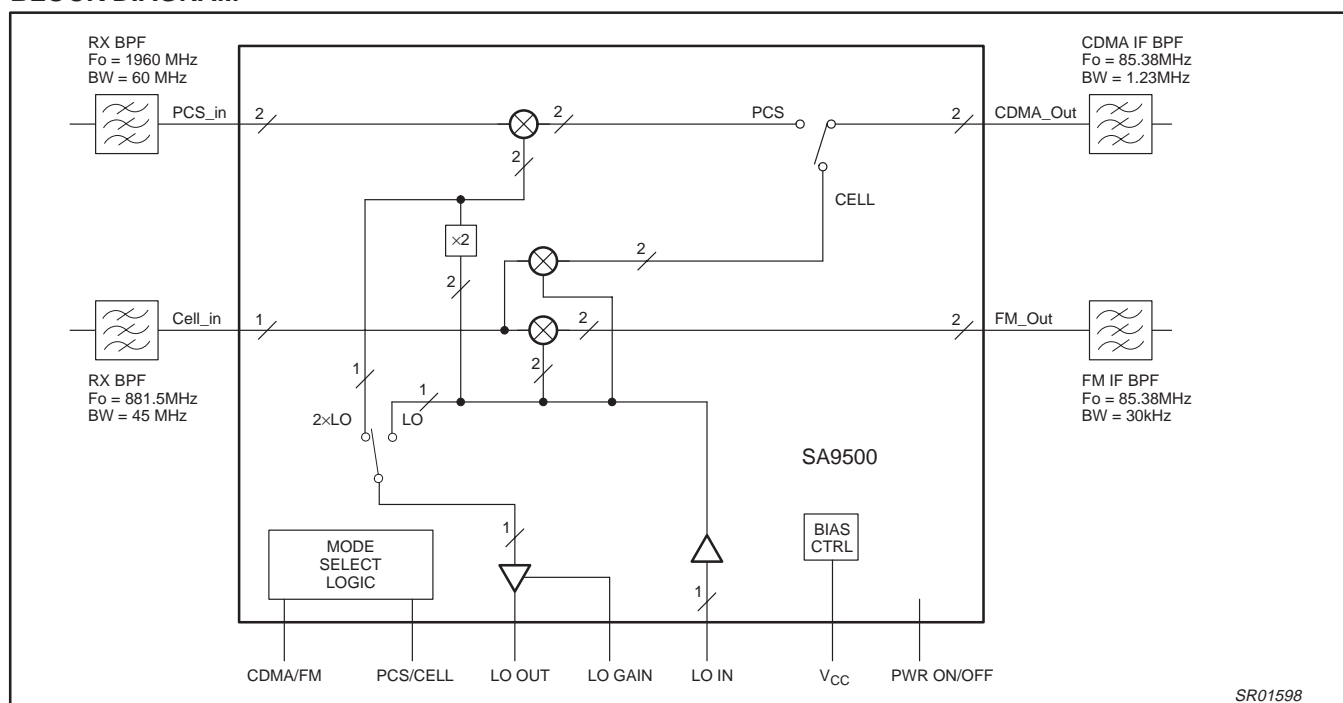


Figure 1. Block Diagram

Table 1. Mode Selection Summary

| PCS/CEL (Pin 6) | CDMA/FM/LO doubler (Pin 17) | MODE |
|-----------------|-----------------------------|---------------------------|
| low | low | Cellular FM |
| low | high | Cellular CDMA |
| high | low | CDMA PCS, 1GHz (LO out) |
| high | high | CDMA PCS, 2GHz (2xLO out) |

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PIN CONFIGURATION

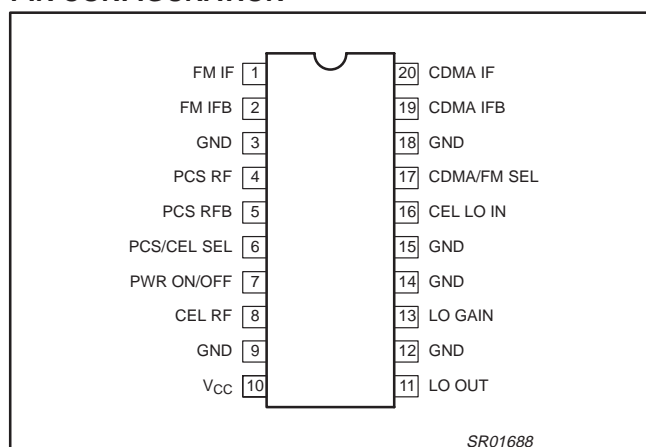


Figure 2. Pin Configuration

PIN DESCRIPTION

| PIN | SYMBOL | DESCRIPTION |
|-----|-----------------|--|
| 1 | FM IF | Non-inverting FM IF output |
| 2 | FM IFB | Inverting FM IF output |
| 3 | GND | Analog ground |
| 4 | PCS RF | non-inverting PCS RF input |
| 5 | PCS RFB | Inverting PCS RF input |
| 6 | PCS/CEL SEL | PCS and cellular band select |
| 7 | PWR ON/OFF | Power enable |
| 8 | CEL RF | Cellular RF input |
| 9 | GND | Ground |
| 10 | V _{CC} | Power supply |
| 11 | LO OUT | LO output to synthesizer |
| 12 | GND | Ground |
| 13 | LO GAIN | Logic signal which adjusts the gain of the LO buffer |
| 14 | GND | Ground |
| 15 | GND | Ground |
| 16 | CEL LO | Cellular LO input |
| 17 | CDMA/FM SEL | CDMA and FM mode select in the cellular band; selects LO buffer output frequency in PCS mode |
| 18 | GND | Ground |
| 19 | CDMA IFB | Inverting CDMA IF output |
| 20 | CDMA IF | Non-inverting CDMA IF output |

FUNCTIONAL DESCRIPTION

Mode Selection Logic

The SA9500 downconverter IC has several modes of operation for which the selection logic is summarized in Table 1 and defined in detail in Table 2. Different mode selections require different portions of the circuit to be active. It should be noted that only the states specified in Table 2 are valid selections for operation.

Local Oscillator Section

Drive for the local oscillator is provided through a single ended input via pin 16. The LO signal has to be AC-coupled into the circuit and needs to be externally matched. Inside the circuit, the LO signal is amplified and buffered to drive: Either the cellular CDMA mixer or FM mixer or the frequency doubler for the PCS mixer LO and additionally one of the LO output buffers. The mode selection summary in Table 1 shows the logic to apply to pins 6 and 17 to choose one of four possible modes. The LO output buffer can supply either the same frequency as that input on pin 16 or doubled frequency LO in CDMA PCS modes. The LO output power range can be programmed between high gain and low gain (idle mode) settings with LO gain on pin 13.

Cellular and PCS Mixers

The SA9500 has one single ended cellular band RF input which feeds either the cellular CDMA mixer or the cellular FM mixer circuits. Each mixer is optimized to meet cellular band CDMA or analog FM requirements. The cellular FM mixer has its own dedicated differential output on pins 1 and 2 which should be externally matched to the FM IF SAW filter. The cellular CDMA mixer shares the same output pins with the CDMA PCS mixer. Selection between these two mixers is via pin 6 (PCS/CEL) and as the two mixers are never on at the same time, it allows a common CDMA SAW filter to be used for both bands. The CDMA PCS mixer has a differential RF input which should be used with an external balun matching circuit. To avoid upsetting the internal biasing, the RF inputs at both cellular and PCS band mixers should be AC-coupled. The CDMA and FM IF mixer outputs are of the open collector type. So, they should be biased to the supply voltage V_{CC} with external tuning inductors which can also serve in the matching of the IF SAW filter.

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ABSOLUTE MAXIMUM RATINGS

| PARAMETER | RATINGS | UNITS |
|---|----------------------|--------------------|
| Supply voltage (V_{CC}) | -0.3 to +6.0 | V |
| Logic input voltage | -0.3 to $V_{CC}+0.3$ | V |
| Maximum power input | +20 | dBm |
| Power dissipation, $T_{amb}=25^{\circ}\text{C}$ | 800 | mW |
| Maximum operating junction temperature | 150 | $^{\circ}\text{C}$ |
| Storage temperature | -65 to +150 | $^{\circ}\text{C}$ |

RECOMMENDED OPERATING CONDITIONS

| PARAMETER | TEST CONDITIONS | LIMITS | | | UNITS |
|---|-----------------|-------------|------|--------------|--------------------|
| | | MIN. | TYP. | MAX. | |
| Supply voltage (V_{CC}) | | 2.7 | 2.85 | 3.3 | V |
| Logic input voltage range | LOW | -0.3 | | $0.2V_{CC}$ | V |
| | HIGH | $0.5V_{CC}$ | | $V_{CC}+0.3$ | V |
| Operating ambient temperature range (T_{amb}) | | -30 | | +85 | $^{\circ}\text{C}$ |
| Operating junction temperature range | | 0 | | 105 | $^{\circ}\text{C}$ |

MODE SELECT LOGIC AND DC CHARACTERISTICS

Table 2. Mode Logic Definition

 $V_{CC} = +2.7\text{ V to }+3.3\text{ V}$; $T_{amb} = -30^{\circ}\text{C to }+85^{\circ}\text{C}$, unless specified otherwise.

| MODE | MODE DESCRIPTION | LO GAIN/ | POWER/ | PCS/CEL | CDMA/FM | TYPICAL CURRENT CONSUMPTION | MAXIMUM CURRENT CONSUMPTION | FIGURE |
|------|--------------------------------|----------|--------|---------|---------|-----------------------------|-----------------------------|--------|
| 1 | PCS RxTx (with doubled LO out) | high | high | high | high | 27.0 mA | 30.6 mA | 3 |
| 2 | PCS Idle (with doubled LO out) | low | high | high | high | 21.3 mA | 24.3 mA | 4 |
| 3 | PCS RxTx | high | high | high | low | 23.5 mA | 26.5 mA | 5 |
| 4 | PCS Rx Idle | low | high | high | low | 20.0 mA | 22.5 mA | 6 |
| 5 | Cellular CDMA RxTx | high | high | low | high | 24 mA | 28 mA | 7 |
| 6 | Cellular CDMA Rx Idle | low | high | low | high | 20.2 mA | 24 mA | 8 |
| 7 | Cellular FM RxTx | high | high | low | low | 11 mA | 14.4 mA | 9 |
| 8 | Cellular FM Rx Idle | low | high | low | low | 7.7 mA | 9.9 mA | 10 |
| 9 | Sleep | x | low | x | x | 12 μA | 60 μA | 11 |

NOTE:

x = Don't care

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AC ELECTRICAL CHARACTERISTICS

$V_{CC} = +2.7V$ to $+3.3V$; $T_{amb} = +25^{\circ}C$; $P_{Io} = -3$ dBm, $f_{IF} = 85.40$ MHz; unless specified otherwise.

Appropriate external matching necessary.

| PARAMETER | TEST CONDITIONS | LIMITS | | | | | UNITS |
|--|--|--------|-------|-------|-------|------|-------|
| | | MIN. | −3σ | TYP. | +3σ | MAX. | |
| Cellular Band Downconverter | | | | | | | |
| RF input frequency range | | 869 | | | | 894 | MHz |
| LO input frequency range | | 950 | | | | 1030 | MHz |
| IF output frequency range (CDMA) | | 50 | | | | 300 | MHz |
| IF output frequency range (FM) | | 50 | | | | 300 | MHz |
| IF output load impedance | CDMA, differential | | | 1000 | | | Ω |
| | FM, single-ended, with ext. balun | | | 850 | | | Ω |
| Conversion gain | CDMA | | 9.5 | 10.7 | 11.6 | | dB |
| | FM | | 5.5 | 7.2 | 7.8 | | dB |
| Noise figure | CDMA mode, SSB | | | 9.6 | 10.5 | | dB |
| | FM mode, SSB | | | 10.2 | 11.0 | | dB |
| Input IP3 | CDMA mode, tone spacing = 800 kHz | | 3.5 | 6.3 | | | dBm |
| | FM mode, tone spacing = 60 kHz | | 4.5 | 5.9 | | | dBm |
| RF input return loss | Z _S = 50Ω | | | 11.0 | | | dB |
| LO input return loss | Z _S = 50Ω | | | 10.0 | | | dB |
| LO output return loss | Z _S = 50Ω | | | 8.0 | | | dB |
| LO input power range | | −6.0 | | −3.0 | | 0.0 | dBm |
| LO output power range | Z _L = 50Ω | | | | | | |
| | with LO buffer @ low gain | | −16.0 | −15.0 | −14.0 | | dBm |
| | with LO buffer @ high gain | | −7.5 | −5.0 | −4.0 | | dBm |
| LO (input and output) to RF leakage | Single-ended in, single-ended out | | | −34.5 | −31.5 | | dBm |
| LO (input and output) to IF leakage (CDMA) | Single-ended in, differential out | | | −33.6 | −29.0 | | dBm |
| LO (input and output) to IF leakage (FM) | Single-ended in, differential out | | | −20.0 | −19.0 | | dBm |
| RF to LO (input) isolation | Single-ended in, single-ended out | | 30 | 32.8 | | | dB |
| RF to IF isolation (CDMA) | Single-ended in, differential out | | 20 | 22.3 | | | dB |
| RF to IF isolation (FM) | Single-ended in, differential out | | 6 | 8.2 | | | dB |
| LO output to LO input isolation | Single-ended in, single-ended out | | 26.5 | 34.5 | | | dB |
| Spurious response rejection | With Tx band interferer at LO input port or LO buffer output port of −40 dBm max and with P _{int} = −31 dBm in Rx band. | | 61.0 | | | | dB |

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AC ELECTRICAL CHARACTERISTICS (continued) $V_{CC} = +2.7V$ to $+3.3V$; $T_{amb} = +25^{\circ}C$; $P_{Io} = -3$ dBm, $f_{IF} = 85.40$ MHz; unless specified otherwise.

Appropriate external matching necessary.

| PARAMETER | TEST CONDITIONS | LIMITS | | | | | UNITS |
|-------------------------------------|--|--------|-------|-------|-------|------|-------|
| | | MIN. | −3σ | TYP. | +3σ | MAX. | |
| PCS Downconverter | | | | | | | |
| RF input frequency range | | 1810 | | | | 1990 | MHz |
| LO input frequency range | With doubler | 1007 | | | | 1050 | MHz |
| IF output frequency range | | 50 | | | | 300 | MHz |
| IF output load impedance | Differential | | | 1000 | | | Ω |
| Conversion gain | @ f _{IF} , over RF/LO frequency ranges | | 9.5 | 11.3 | 11.7 | | dB |
| Noise figure | @ f _{IF} , over RF/LO frequency ranges, SSB | | | 8.3 | 10.5 | | dB |
| Input IP3 | @ f _{IF} , over RF/LO frequency ranges | | 1.0 | 1.4 | | | dBm |
| RF input return loss | Z _S = 50Ω, with external balun | | | 7.5 | | | dB |
| LO input return loss | Z _S = 50Ω | | | 10 | | | dB |
| LO output return loss | Z _S = 50Ω, single LO out | | | 8 | | | dB |
| LO input power range | | −6 | | −3 | | 0 | dBm |
| LO output power range | Z _L = 50Ω, single LO out with LO buffer @ low gain with LO buffer @ high gain | | −16.0 | −15.0 | −14.0 | | dBm |
| | | | −7.5 | −5.0 | −4.0 | | dBm |
| LO (input and output) to RF leakage | Single-ended in, single-ended out, with and without doubler | | | −39.0 | −35 | | dBm |
| LO (input and output) to IF leakage | Single-ended in, differential out, with and without doubler | | | −47.0 | −35 | | dBm |
| RF to LO (input) isolation | Single-ended in, single-ended out, with and without doubler | | 30 | 56.0 | | | dB |
| RF to IF isolation | Single-ended in, differential out | | 20 | 42.0 | | | dB |
| LO output to LO input isolation | Single-ended in, single-ended out, with doubler | | 30 | 35.0 | | | dB |
| Spurious response rejection | 1/2 IF spur, f _{IF} = 85.4 MHz/111.38 MHz, with and without doubler, P _{int} = −30 dBm at RF input. | | 56.0 | 58.0 | | | dB |
| | With Tx band interferer at LO input port or LO buffer output port of −40 dBm max and with P _{int} = −21 dBm in Rx band. | | 71.0 | | | | dB |

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PERFORMANCE CHARACTERISTICS

DC Current Consumption / Mixer Noise Figure

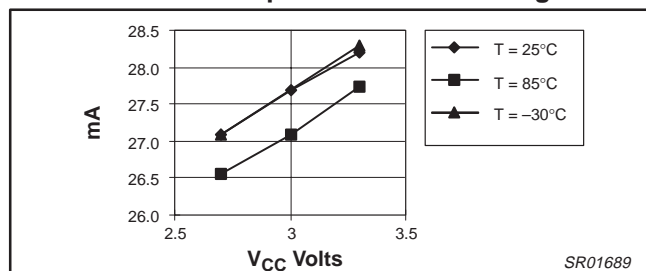


Figure 3. PCS RxTx (with doubled LO out) current

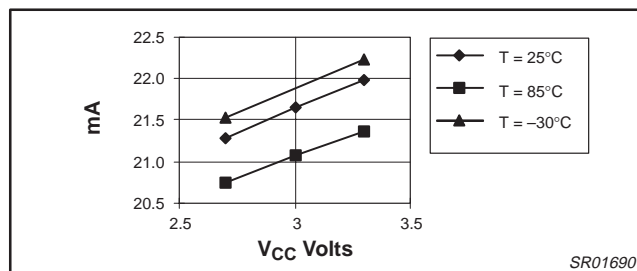


Figure 4. PCS Idle (with doubled LO out) current

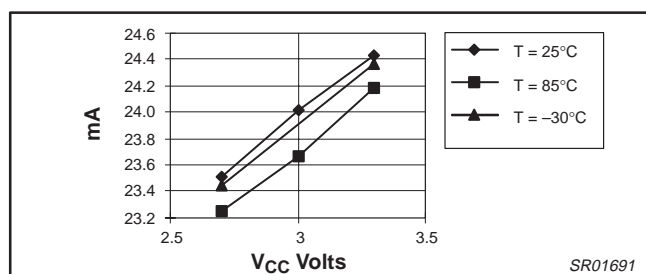


Figure 5. PCS RxTx current

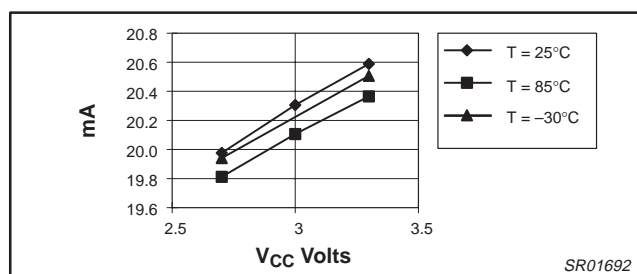


Figure 6. PCS Rx Idle current

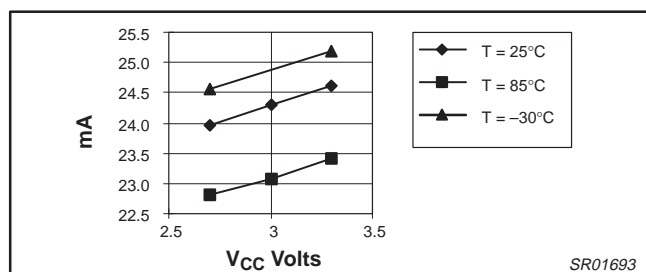


Figure 7. Cellular CDMA RxTx current

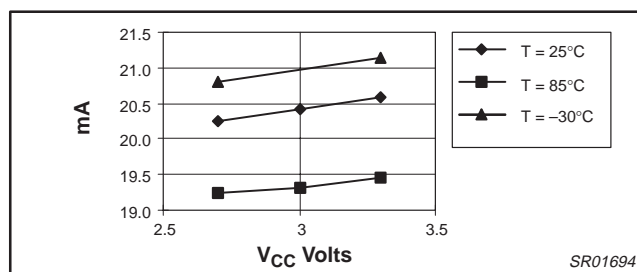


Figure 8. Cellular CDMA Rx Idle current

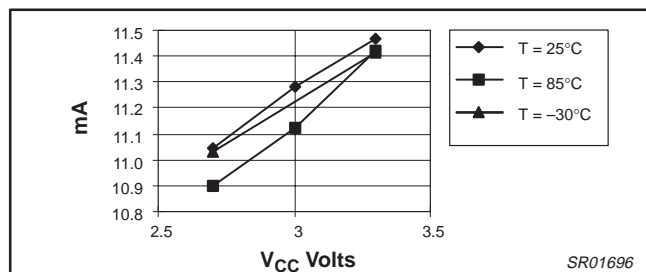


Figure 9. Cellular FM RxTx current

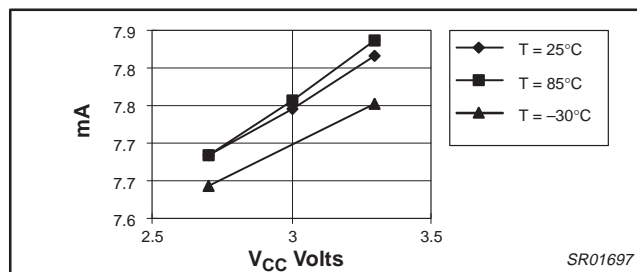


Figure 10. Cellular FM Rx Idle current

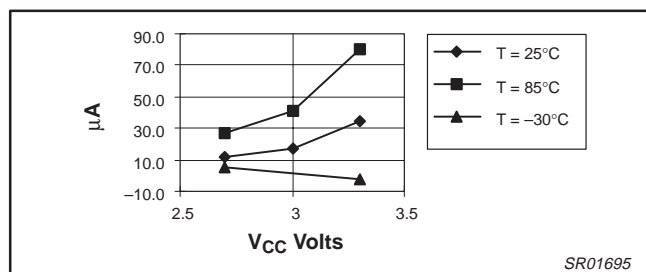
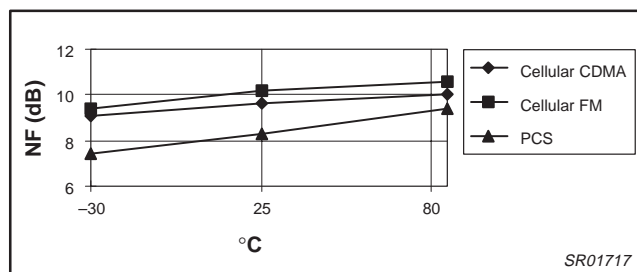


Figure 11. Sleep current

Figure 12. Mixer Noise Figure ($V_{CC} = 2.7V$)

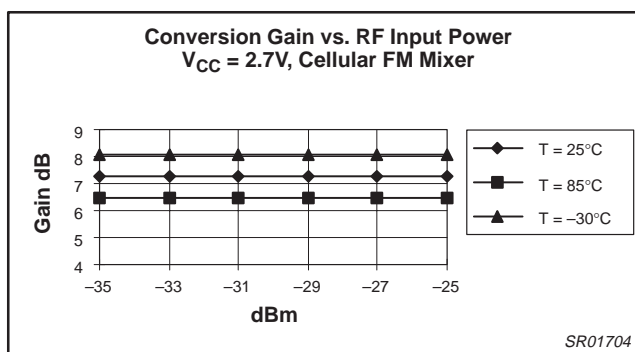
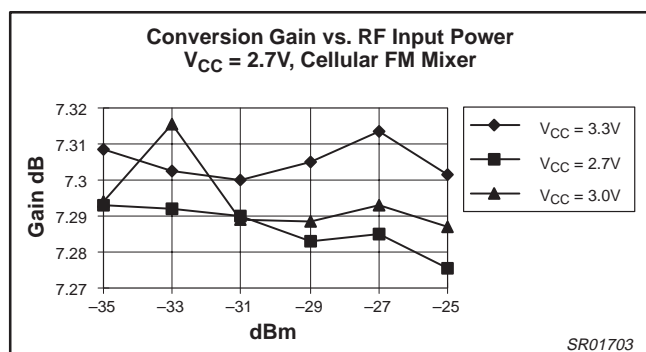
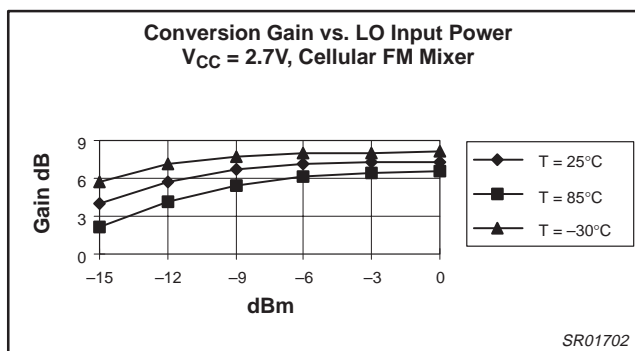
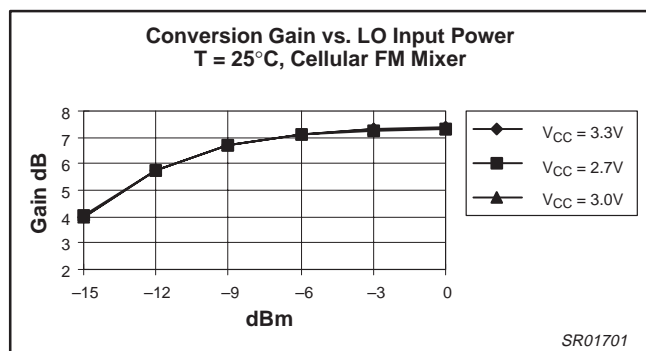
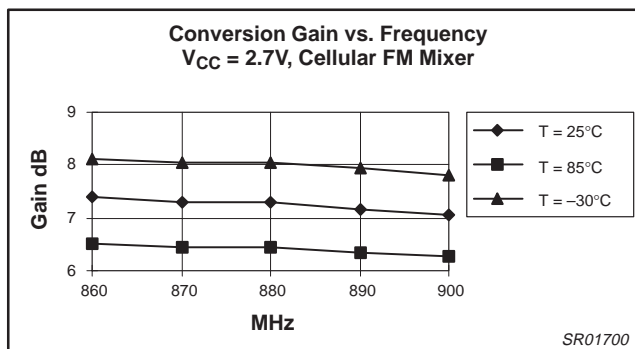
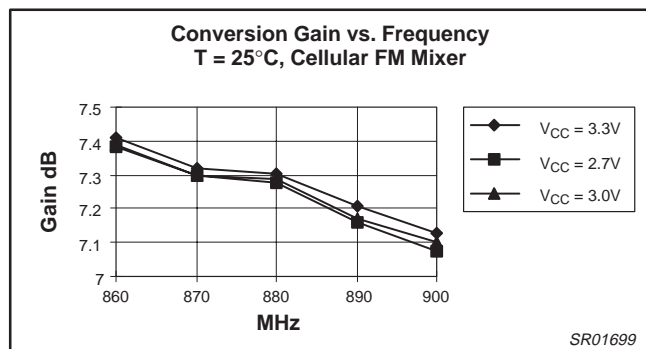
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PERFORMANCE CHARACTERISTICS

Conversion Gain – FM Mixer

$f_{LO} = 965.9\text{MHz}$ @ -3dBm , $f_{RF} = 880.5\text{MHz}$ @ -30dBm , $f_{IF} = 85.4\text{MHz}$: unless otherwise specified or implied.



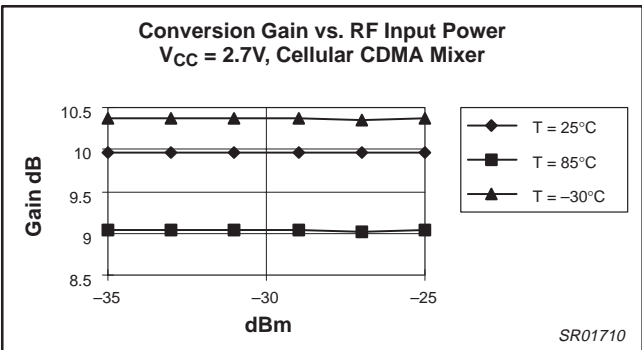
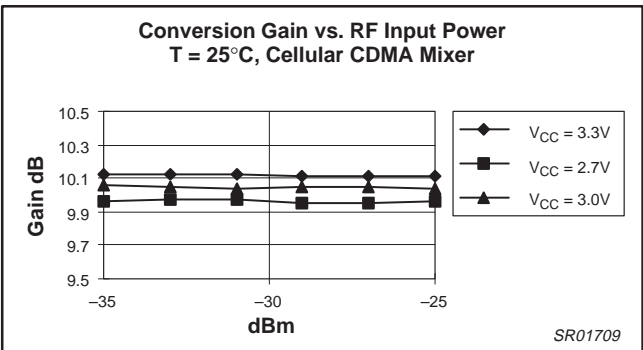
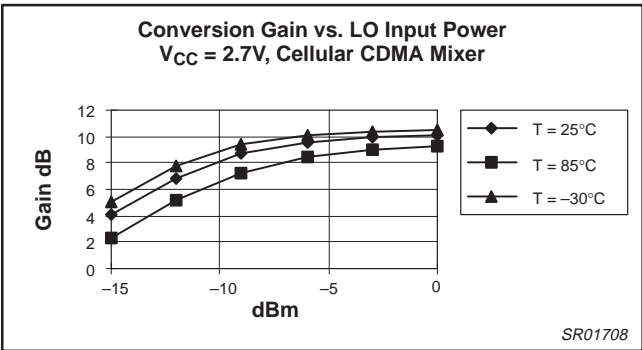
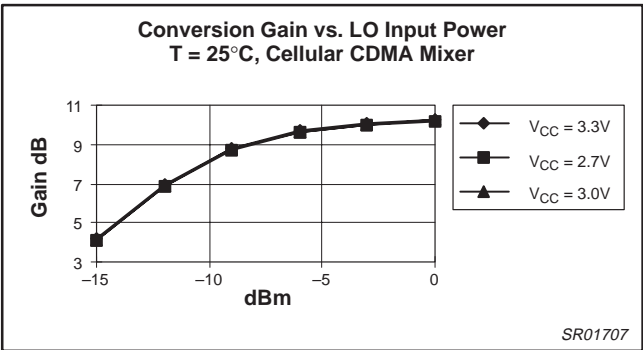
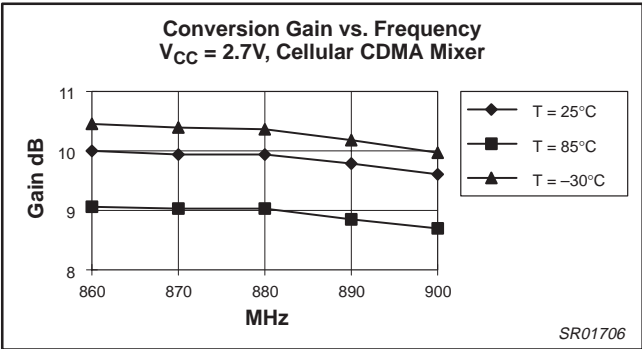
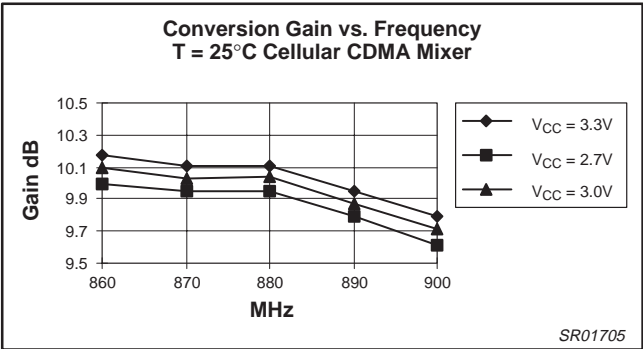
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Conversion Gain – Cellular Band CDMA Mixer

f_{LO} = 965.9MHz @ -3dBm, f_{RF} = 880.5MHz @ -30dBm, f_{IF} = 85.4MHz: unless otherwise specified or implied.



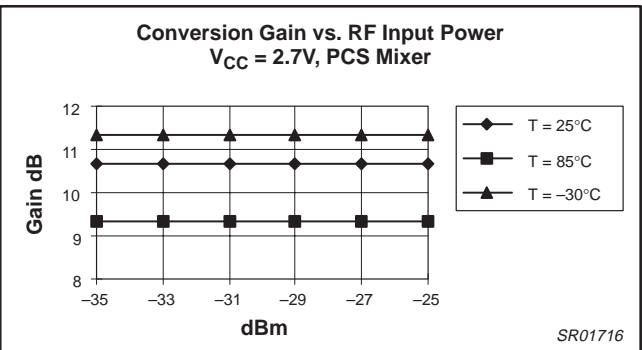
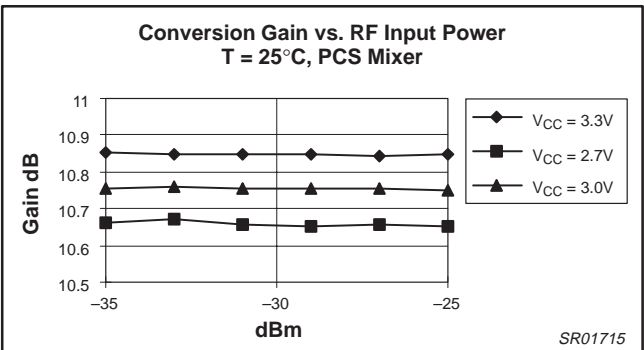
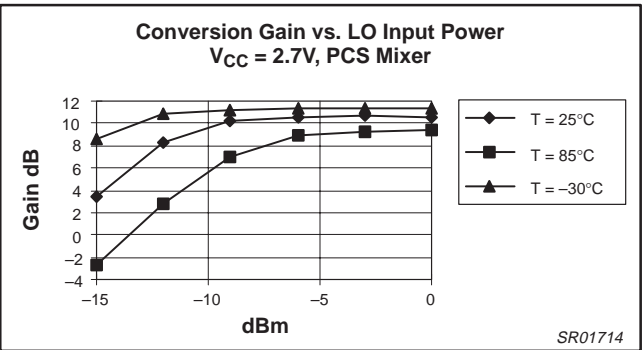
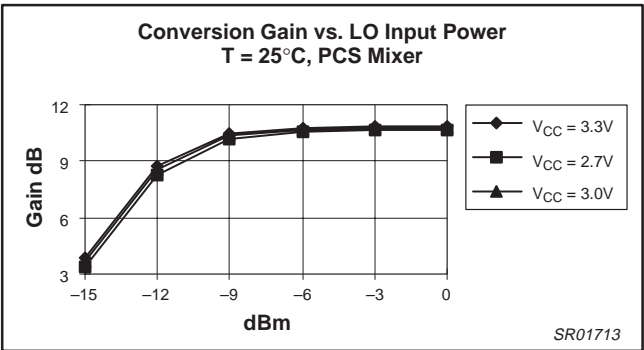
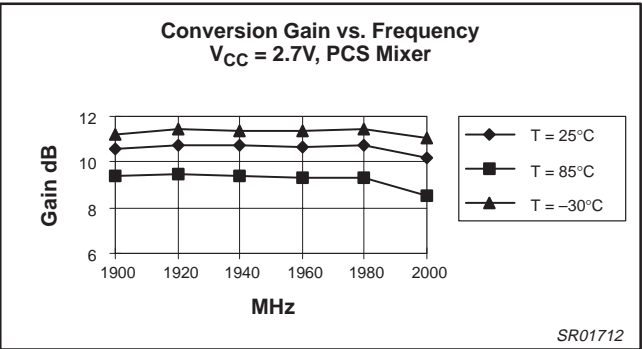
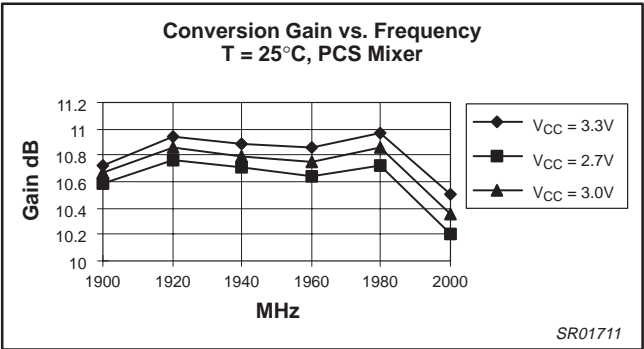
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PERFORMANCE CHARACTERISTICS

Conversion Gain – PCS Mixer

$f_{LO} = 1022.45\text{MHz}$ (doubled on-chip) @ -3dBm , $f_{RF} = 1959.5\text{MHz}$ @ -30dBm , $f_{IF} = 85.4\text{MHz}$: unless otherwise specified or implied.

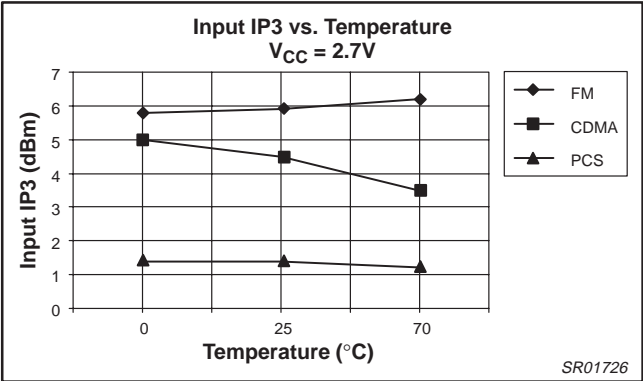


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PERFORMANCE CHARACTERISTICS

Input IP3



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PERFORMANCE CHARACTERISTICS

S-Parameters

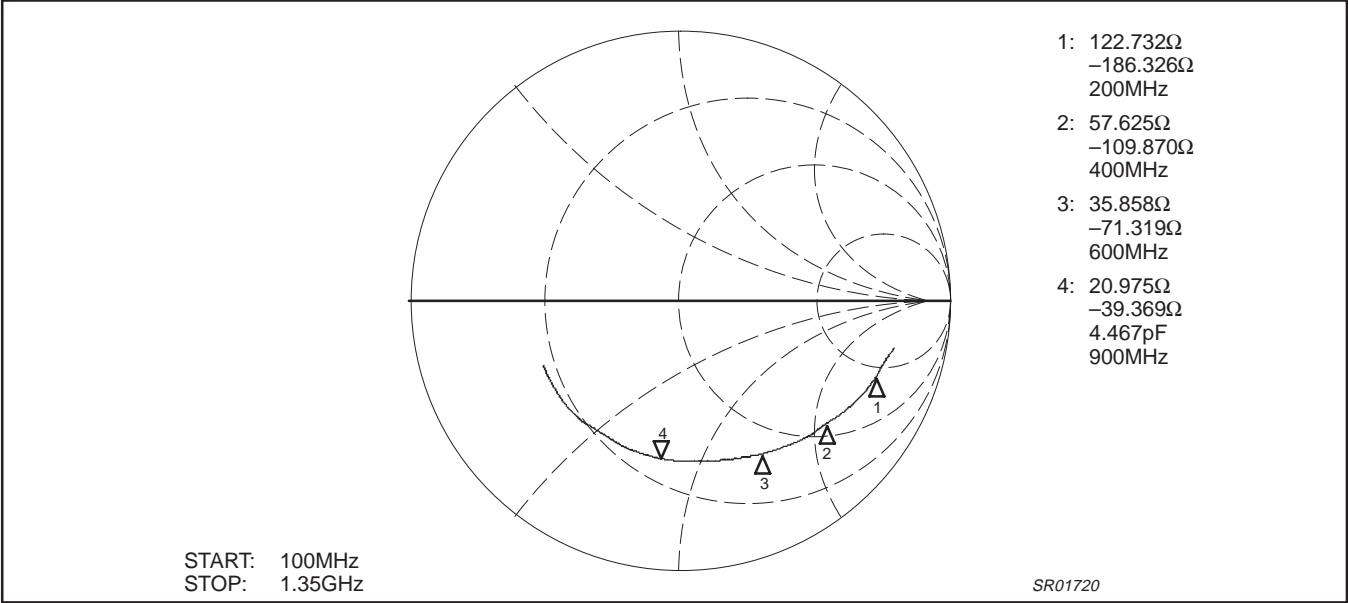


Figure 13. Typical S_{11} of Cellular RF Input for CDMA Mode @ $V_{CC} = 2.8V$

Table 3. Typical S-Parameter of Cellular RF Input for CDMA and FM Mode @ $V_{CC} = 2.8V$

| Frequency (MHz) | CDMA Mode | | FM Mode | |
|-----------------|------------|-----------------------|------------|-----------------------|
| | $ S_{11} $ | $\angle S_{11}$ (DEG) | $ S_{11} $ | $\angle S_{11}$ (DEG) |
| 100 | 0.82 | -12.7 | 0.77 | -10.9 |
| 150 | 0.80 | -16.8 | 0.76 | -15.1 |
| 200 | 0.79 | -21.5 | 0.75 | -19.9 |
| 250 | 0.77 | -26.2 | 0.74 | -25.0 |
| 300 | 0.75 | -30.9 | 0.72 | -29.9 |
| 350 | 0.74 | -35.7 | 0.70 | -34.9 |
| 400 | 0.72 | -40.4 | 0.68 | -39.8 |
| 450 | 0.70 | -45.5 | 0.65 | -44.5 |
| 500 | 0.68 | -50.6 | 0.63 | -48.6 |
| 550 | 0.66 | -56.4 | 0.60 | -53.1 |
| 600 | 0.65 | -61.5 | 0.58 | -56.9 |
| 650 | 0.64 | -67.1 | 0.57 | -60.6 |
| 700 | 0.62 | -72.6 | 0.56 | -64.5 |
| 750 | 0.61 | -78.6 | 0.56 | -68.5 |
| 800 | 0.60 | -84.1 | 0.58 | -74.2 |
| 850 | 0.59 | -90.3 | 0.57 | -84.4 |
| 900 | 0.59 | -96.9 | 0.53 | -89.7 |
| 950 | 0.58 | -104.1 | 0.51 | -93.9 |
| 1000 | 0.58 | -110.4 | 0.50 | -97.8 |
| 1050 | 0.57 | -116.8 | 0.50 | -102.4 |
| 1100 | 0.57 | -123.2 | 0.50 | -107.3 |
| 1150 | 0.56 | -129.8 | 0.50 | -112.4 |
| 1200 | 0.56 | -136.2 | 0.51 | -117.5 |
| 1250 | 0.56 | -142.3 | 0.51 | -122.1 |
| 1300 | 0.55 | -148.4 | 0.52 | -126.6 |
| 1350 | 0.54 | -155.1 | 0.52 | -131.3 |

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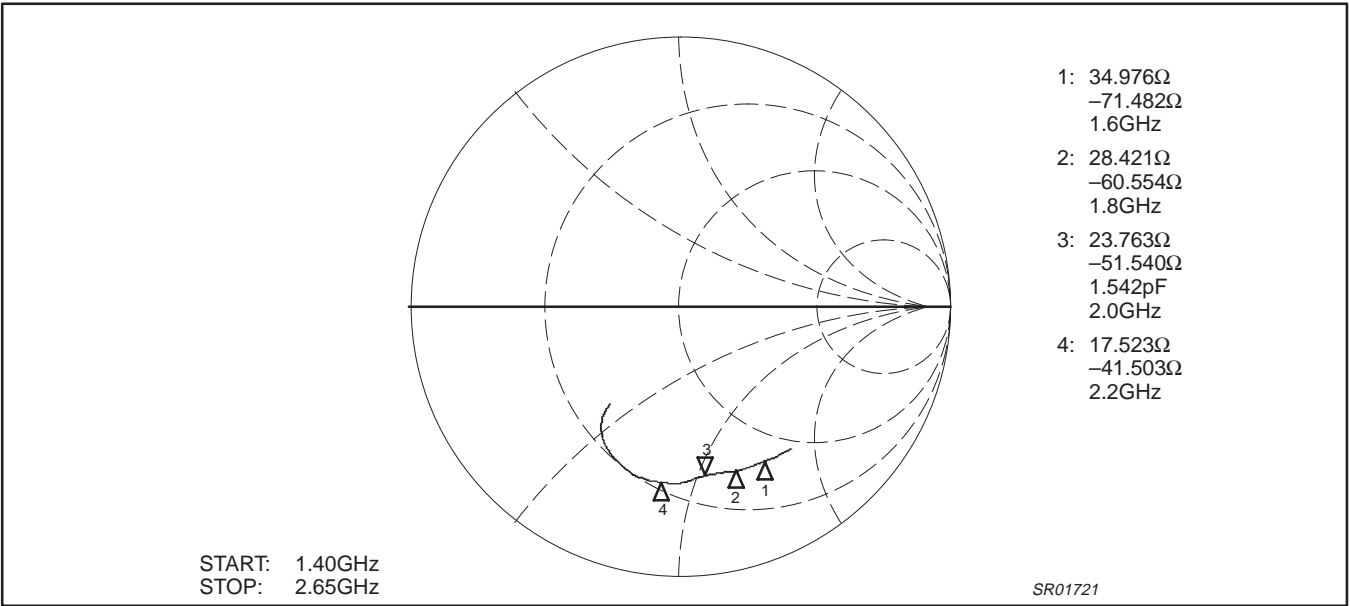


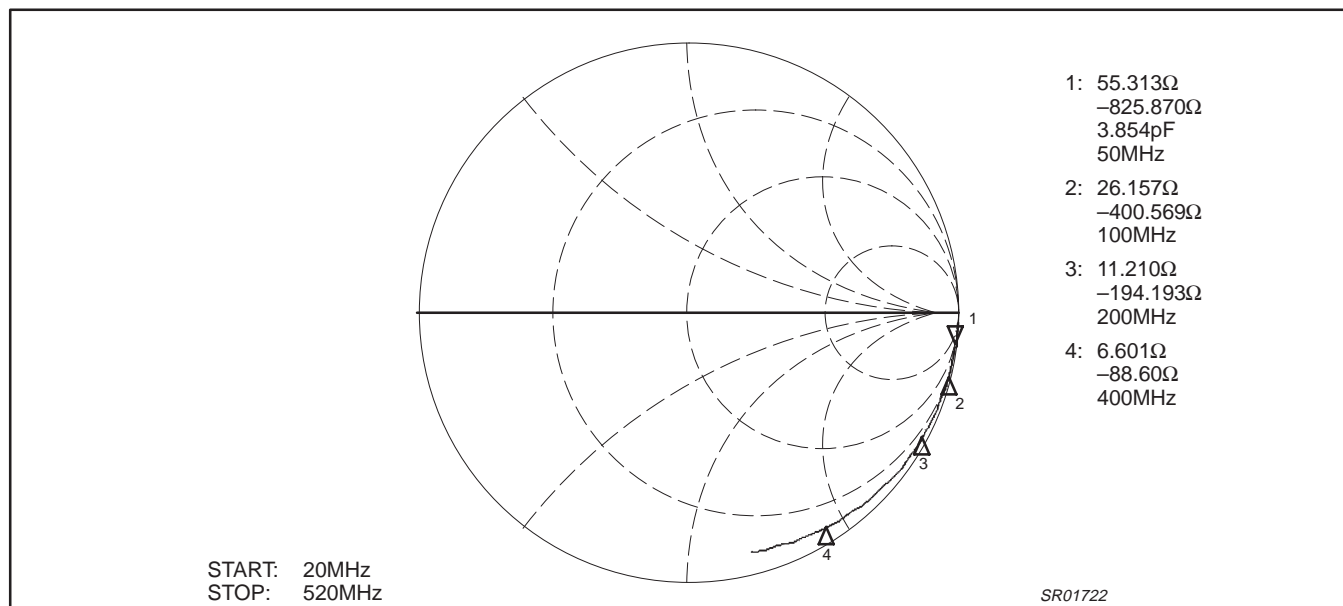
Figure 14. Typical S_{11} of PCS RF and PCS RFB Input @ $V_{CC} = 2.8V$

Table 4. Typical S-Parameter of PCS RF and PCS RFB Input @ $V_{CC} = 2.8V$

| Frequency (MHz) | $ S_{11} $ | $\angle S_{11}$ (DEG) |
|-----------------|------------|-----------------------|
| 1400 | 0.68 | -52.9 |
| 1450 | 0.67 | -55.0 |
| 1500 | 0.67 | -57.6 |
| 1550 | 0.66 | -59.6 |
| 1600 | 0.66 | -61.8 |
| 1650 | 0.66 | -64.2 |
| 1700 | 0.65 | -66.5 |
| 1750 | 0.65 | -69.0 |
| 1800 | 0.65 | -71.9 |
| 1850 | 0.65 | -74.7 |
| 1900 | 0.64 | -77.2 |
| 1950 | 0.64 | -80.0 |
| 2000 | 0.64 | -82.0 |
| 2050 | 0.65 | -85.0 |
| 2100 | 0.66 | -88.3 |
| 2150 | 0.67 | -92.1 |
| 2200 | 0.66 | -96.5 |
| 2250 | 0.66 | -100.8 |
| 2300 | 0.65 | -105.6 |
| 2350 | 0.63 | -110.3 |
| 2400 | 0.61 | -114.7 |
| 2450 | 0.58 | -118.9 |
| 2500 | 0.54 | -122.3 |
| 2550 | 0.50 | -124.2 |
| 2600 | 0.47 | -125.0 |
| 2650 | 0.45 | -125.1 |

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Figure 15. Typical S_{22} of CDMA IF, CDMA IFB Output at $V_{CC} = 2.8V$ Table 5. Typical S-Parameter of CDMA IF and CDMA IFB, FM IF and FM IFB Output @ $V_{CC} = 2.8V$

| Frequency (MHz) | CDMA If and CDMA IFB | | FM IF and FM IFB Output | |
|-----------------|----------------------|-----------------------|-------------------------|-----------------------|
| | $ S_{22} $ | $\angle S_{22}$ (DEG) | $ S_{22} $ | $\angle S_{22}$ (DEG) |
| 20 | 0.99 | -2.8 | 0.99 | -3.5 |
| 40 | 0.99 | -5.6 | 0.99 | -7.0 |
| 60 | 0.99 | -8.5 | 0.99 | -10.3 |
| 80 | 0.98 | -11.3 | 0.98 | -13.7 |
| 100 | 0.98 | -14.2 | 0.98 | -17.2 |
| 120 | 0.98 | -17.0 | 0.98 | -20.7 |
| 140 | 0.98 | -19.9 | 0.98 | -24.2 |
| 160 | 0.98 | -22.9 | 0.98 | -27.7 |
| 180 | 0.97 | -25.8 | 0.97 | -31.2 |
| 200 | 0.97 | -28.8 | 0.97 | -34.7 |
| 220 | 0.97 | -31.5 | 0.96 | -37.9 |
| 240 | 0.97 | -34.6 | 0.96 | -41.5 |
| 260 | 0.97 | -37.6 | 0.95 | -45.1 |
| 280 | 0.96 | -40.4 | 0.95 | -48.6 |
| 300 | 0.96 | -43.5 | 0.94 | -52.1 |
| 320 | 0.96 | -46.4 | 0.94 | -55.5 |
| 340 | 0.95 | -49.3 | 0.93 | -58.9 |
| 360 | 0.95 | -52.6 | 0.92 | -62.5 |
| 380 | 0.94 | -55.4 | 0.91 | -65.9 |
| 400 | 0.94 | -58.7 | 0.90 | -69.5 |
| 420 | 0.94 | -61.3 | 0.90 | -72.5 |
| 440 | 0.93 | -64.4 | 0.89 | -76.0 |
| 460 | 0.93 | -67.6 | 0.88 | -79.6 |
| 480 | 0.92 | -70.8 | 0.87 | -83.0 |
| 500 | 0.92 | -74.1 | 0.87 | -86.7 |
| 520 | 0.91 | -77.1 | 0.86 | -89.8 |

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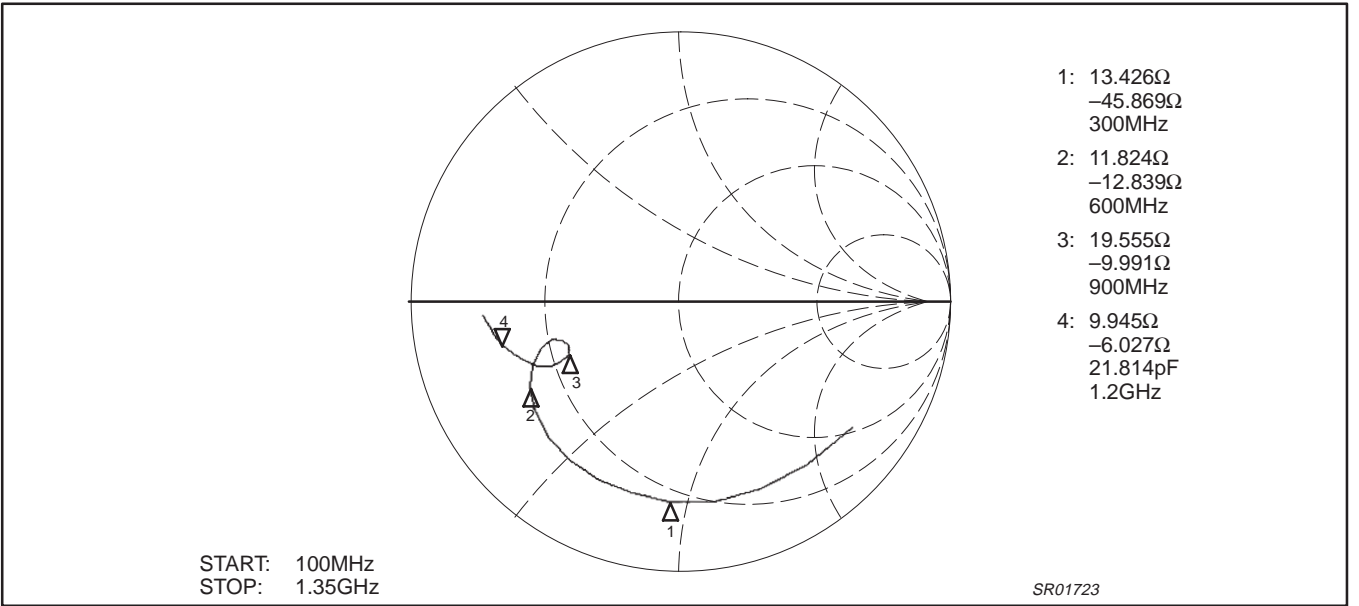


Figure 16. Typical S_{11} of LO Input @ $V_{CC} = 2.8V$

Table 6. Typical S-Parameter of LO Input @ $V_{CC} = 2.8V$

| Frequency (MHz) | $ S_{11} $ | $\angle S_{11}$ (DEG) |
|-----------------|------------|-----------------------|
| 100 | 0.80 | -36.7 |
| 150 | 0.77 | -52.1 |
| 200 | 0.76 | -66.9 |
| 250 | 0.76 | -80.4 |
| 300 | 0.75 | -92.7 |
| 350 | 0.74 | -103.8 |
| 400 | 0.73 | -114.0 |
| 450 | 0.72 | -123.9 |
| 500 | 0.70 | -133.1 |
| 550 | 0.67 | -141.7 |
| 600 | 0.64 | -149.7 |
| 650 | 0.59 | -156.1 |
| 700 | 0.54 | -160.9 |
| 750 | 0.49 | -162.7 |
| 800 | 0.45 | -160.9 |
| 850 | 0.44 | -157.4 |
| 900 | 0.46 | -153.7 |
| 950 | 0.49 | -152.4 |
| 1000 | 0.54 | -152.9 |
| 1050 | 0.57 | -155.3 |
| 1100 | 0.61 | -158.4 |
| 1150 | 0.64 | -162.0 |
| 1200 | 0.67 | -165.7 |
| 1250 | 0.69 | -168.9 |
| 1300 | 0.71 | -172.1 |
| 1350 | 0.73 | -175.2 |

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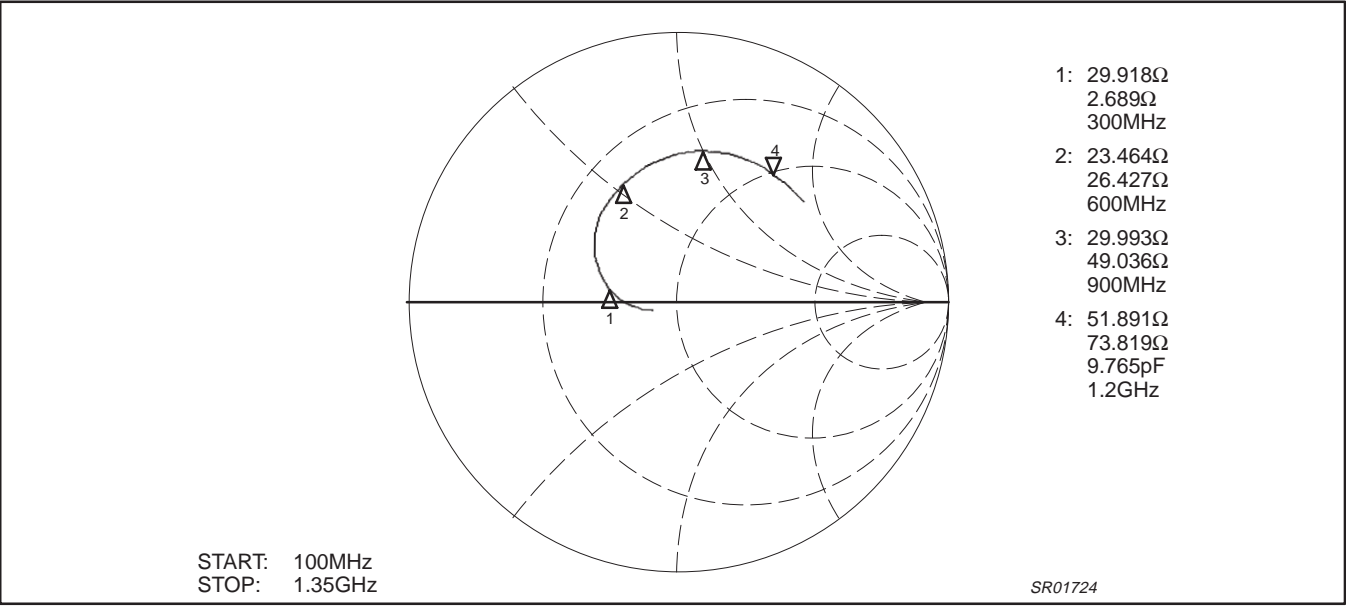


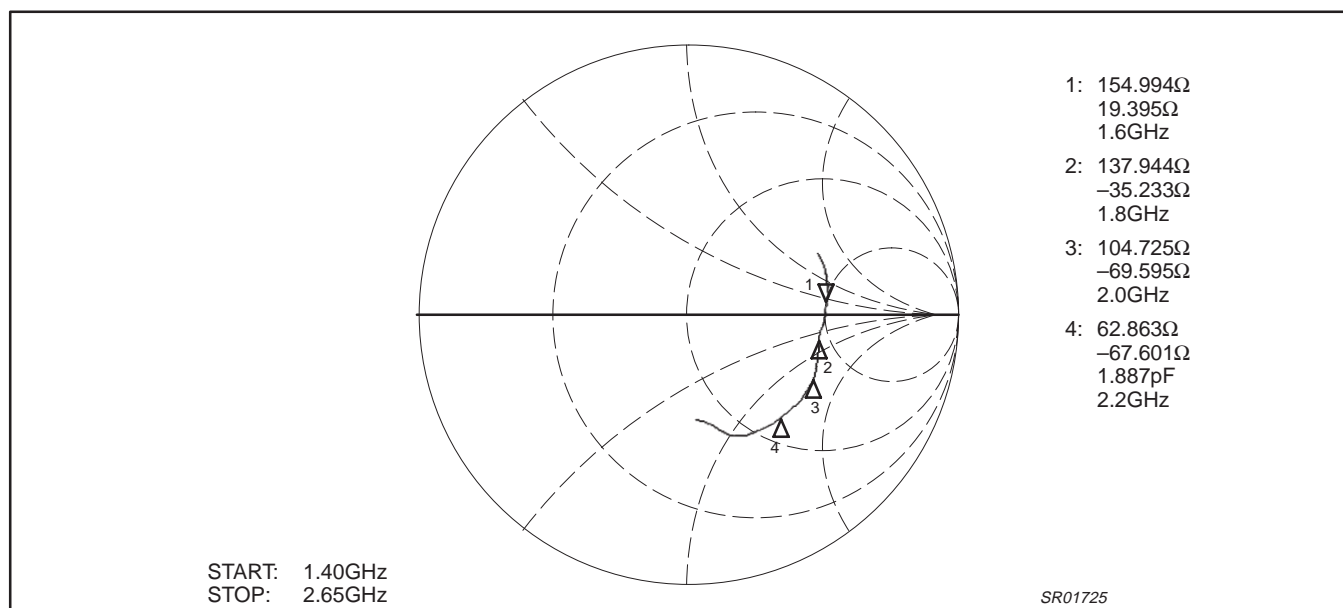
Figure 17. Typical S₂₂ of LO Output for Cellular Band without Frequency Doubler @ V_{CC} = 2.8V

Table 7. Typical S-Parameter of LO Output without Doubler @ V_{CC} = 2.8V

| Frequency (MHz) | S ₂₂ | <S ₂₂ (DEG) |
|-----------------|-----------------|------------------------|
| 100 | 0.10 | -161.1 |
| 150 | 0.13 | -165.3 |
| 200 | 0.17 | -172.6 |
| 250 | 0.21 | 179.5 |
| 300 | 0.25 | 170.5 |
| 350 | 0.30 | 160.7 |
| 400 | 0.35 | 150.9 |
| 450 | 0.40 | 141.0 |
| 500 | 0.43 | 131.2 |
| 550 | 0.46 | 123.1 |
| 600 | 0.48 | 115.3 |
| 650 | 0.50 | 108.6 |
| 700 | 0.52 | 102.2 |
| 750 | 0.53 | 96.2 |
| 800 | 0.55 | 90.9 |
| 850 | 0.56 | 85.7 |
| 900 | 0.56 | 80.7 |
| 950 | 0.57 | 75.9 |
| 1000 | 0.58 | 71.2 |
| 1050 | 0.58 | 66.7 |
| 1100 | 0.59 | 61.8 |
| 1150 | 0.59 | 57.4 |
| 1200 | 0.59 | 52.6 |
| 1250 | 0.59 | 47.7 |
| 1300 | 0.59 | 43.1 |
| 1350 | 0.59 | 38.7 |

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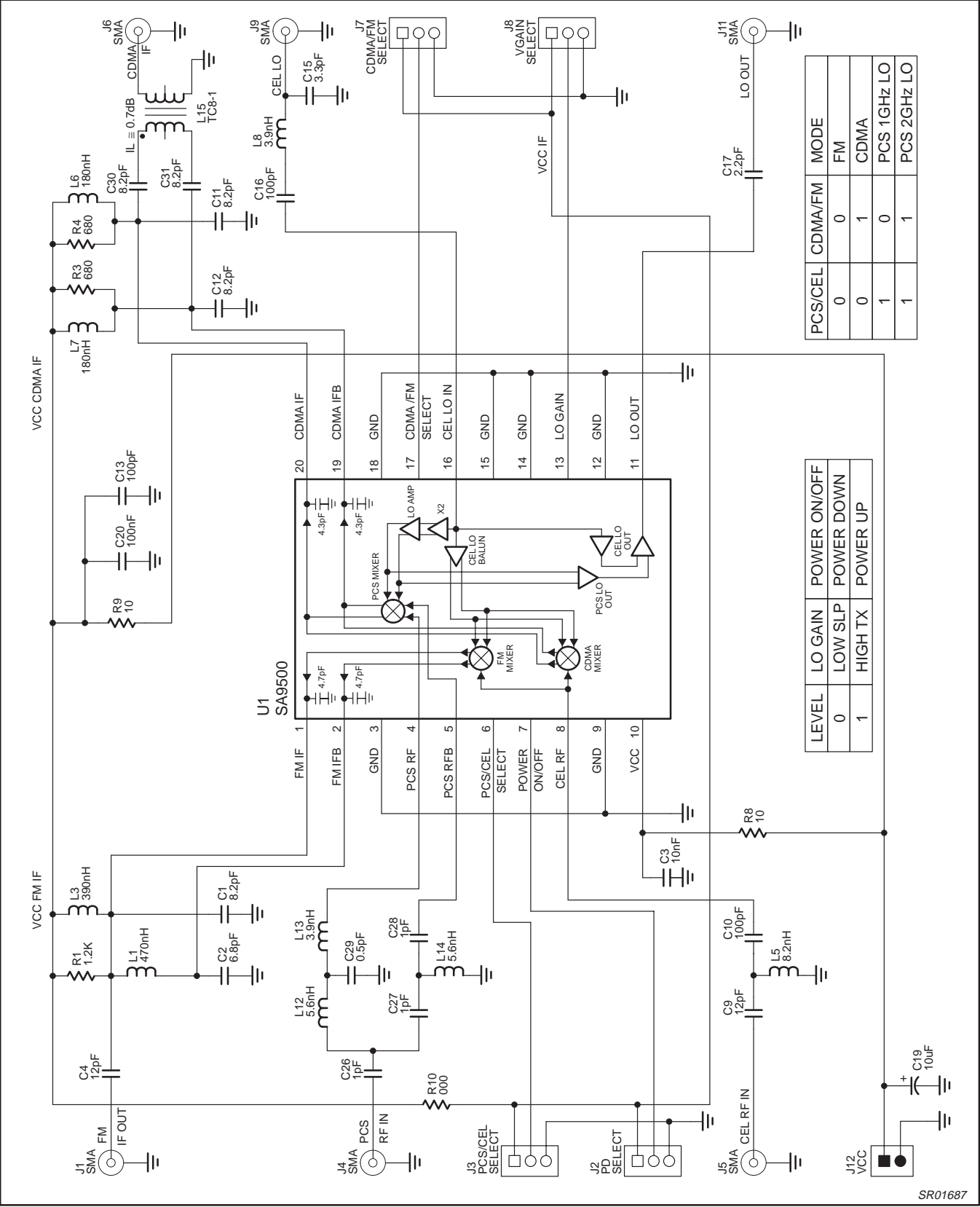
Figure 18. Typical S_{22} of LO Output for PCS Band with Doubler @ $V_{CC} = 2.8V$ Table 8. Typical S-Parameter of LO Output for PCS Band with Doubler @ $V_{CC} = 2.8V$

| Frequency (MHz) | $ S_{22} $ | $\angle S_{22}$ (DEG) |
|-----------------|------------|-----------------------|
| 1400 | 0.53 | 25.1 |
| 1450 | 0.54 | 19.9 |
| 1500 | 0.53 | 14.7 |
| 1550 | 0.53 | 9.9 |
| 1600 | 0.52 | 5.1 |
| 1650 | 0.51 | 0.1 |
| 1700 | 0.51 | -3.7 |
| 1750 | 0.50 | -8.0 |
| 1800 | 0.50 | -11.2 |
| 1850 | 0.50 | -14.5 |
| 1900 | 0.51 | -18.7 |
| 1950 | 0.52 | -23.2 |
| 2000 | 0.52 | -27.6 |
| 2050 | 0.53 | -33.0 |
| 2100 | 0.53 | -37.9 |
| 2150 | 0.53 | -43.2 |
| 2200 | 0.52 | -48.3 |
| 2250 | 0.52 | -53.2 |
| 2300 | 0.51 | -58.5 |
| 2350 | 0.50 | -64.5 |
| 2400 | 0.48 | -69.5 |
| 2450 | 0.45 | -73.8 |
| 2500 | 0.42 | -76.4 |
| 2550 | 0.41 | -78.6 |
| 2600 | 0.40 | -81.2 |
| 2650 | 0.40 | -84.8 |

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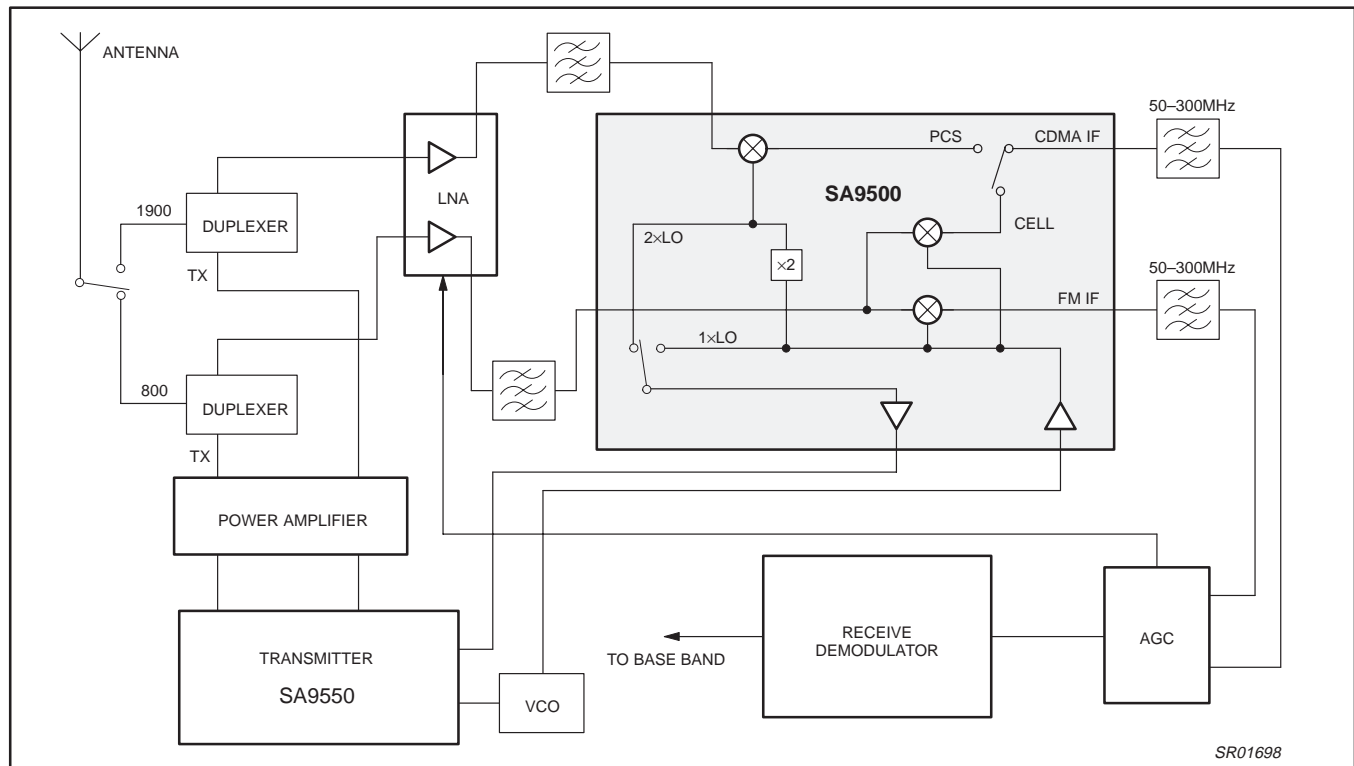
DEMONSTRATION BOARD DIAGRAM



Dual-band, CDMA/AMPS downconverter IC

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APPLICATION BLOCK DIAGRAM

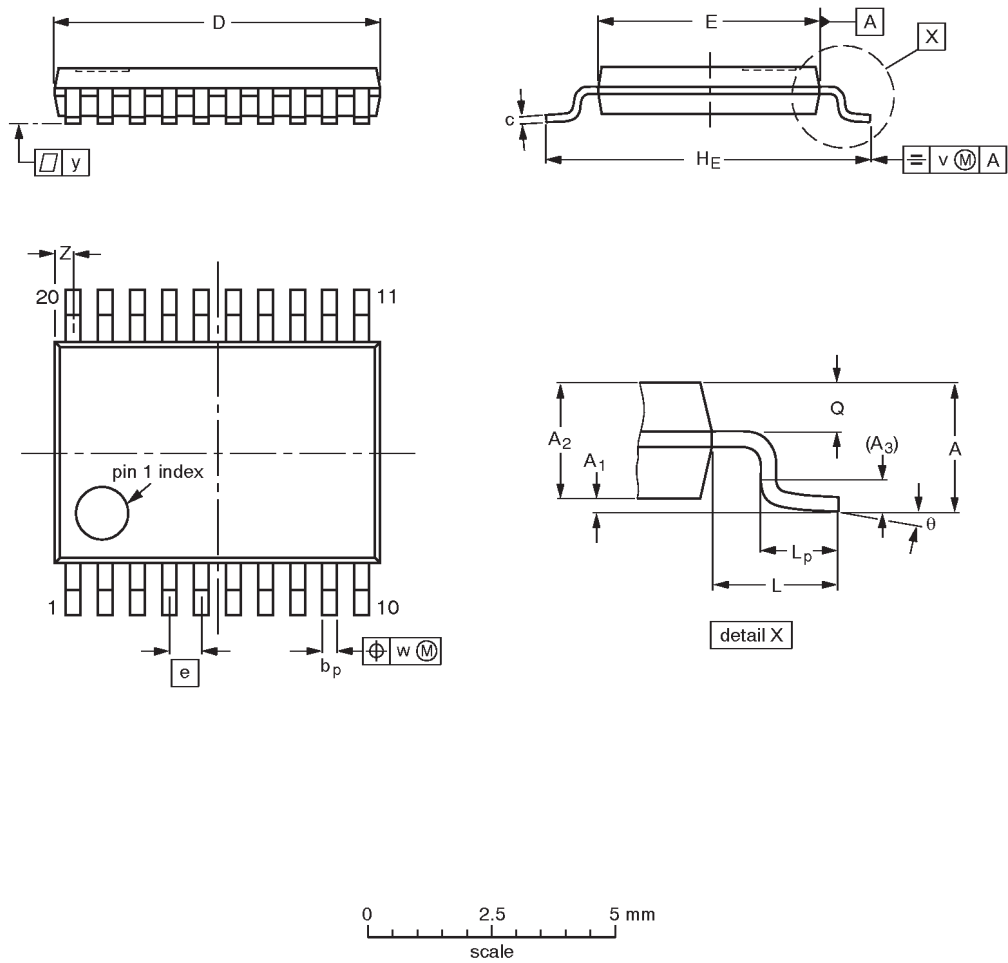


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TSSOP20: plastic thin shrink small outline package; 20 leads; body width 4.4 mm

SOT360-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|-----------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|-----|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.10 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 6.6 6.4 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1.0 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.5 0.2 | 8° 0° |

- Notes
- 1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
 - 2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|--------------------|------------|----------|------|--|------------------------|-----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT360-1 | | MO-153AC | | | | -93-06-16 95-02-04 |

Dual-band, CDMA/AMPS downconverter IC

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| Data sheet status | Product status | Definition [1] |
|---------------------------|----------------|--|
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| Preliminary specification | Qualification | This data sheet contains preliminary data, and supplementary data will be published at a later date. Philips Semiconductors reserves the right to make changes at any time without notice in order to improve design and supply the best possible product. |
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[1] Please consult the most recently issued datasheet before initiating or completing a design.

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