

DATA SHEET

SA601

Low voltage LNA and mixer – 1 GHz

Product data
Supersedes data of 1994 Dec 15

2004 Dec 14

1GHz low voltage LNA and mixer

SA601

DESCRIPTION

The SA601 is a combined RF amplifier and mixer designed for high-performance low-power communication systems from 800-1200MHz. The low-noise preamplifier has a 1.6dB noise figure at 900MHz with 11.5dB gain and an IP3 intercept of -2dBm 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 a 9.5dB noise figure and IP3 of -2dBm at the input at 900MHz. The nominal current drawn from a single 3V supply is 7.4mA. The Mixer can be powered down to further reduce the supply current to 4.4mA.

FEATURES

- Low current consumption: 7.4mA nominal, 4.4mA with the mixer powered-down
- Outstanding LNA noise figure: 1.6dB at 900MHz
- High system power gain: 18dB (LNA + Mixer) at 900MHz
- Excellent gain stability versus temperature and supply voltage
- External >-7dBm LO can be used to drive the mixer

PIN CONFIGURATION

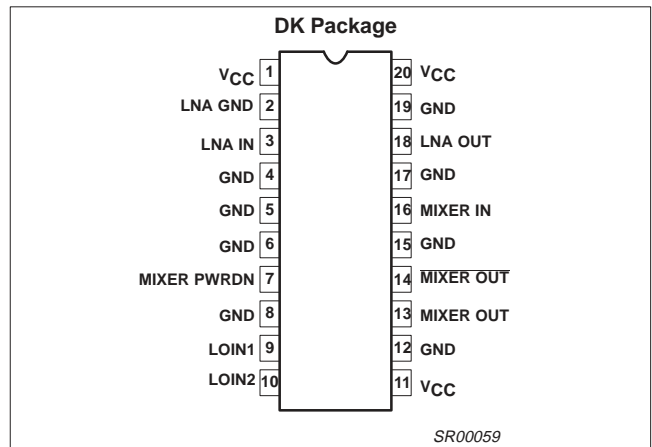


Figure 1. Pin Configuration

APPLICATIONS

- 900MHz cellular front-end (NADC, GSM, AMPS, TACS)
- 900MHz cordless front-end (CT1, CT2)
- 900MHz receivers

ORDERING INFORMATION

| DESCRIPTION | TEMPERATURE RANGE | ORDER CODE | DWG # |
|---|-------------------|------------|----------|
| 20-Pin Plastic Shrink Small Outline Package (Surface-mount, SSOP) | -40 to +85°C | SA601DK | SOT266-1 |

BLOCK DIAGRAM

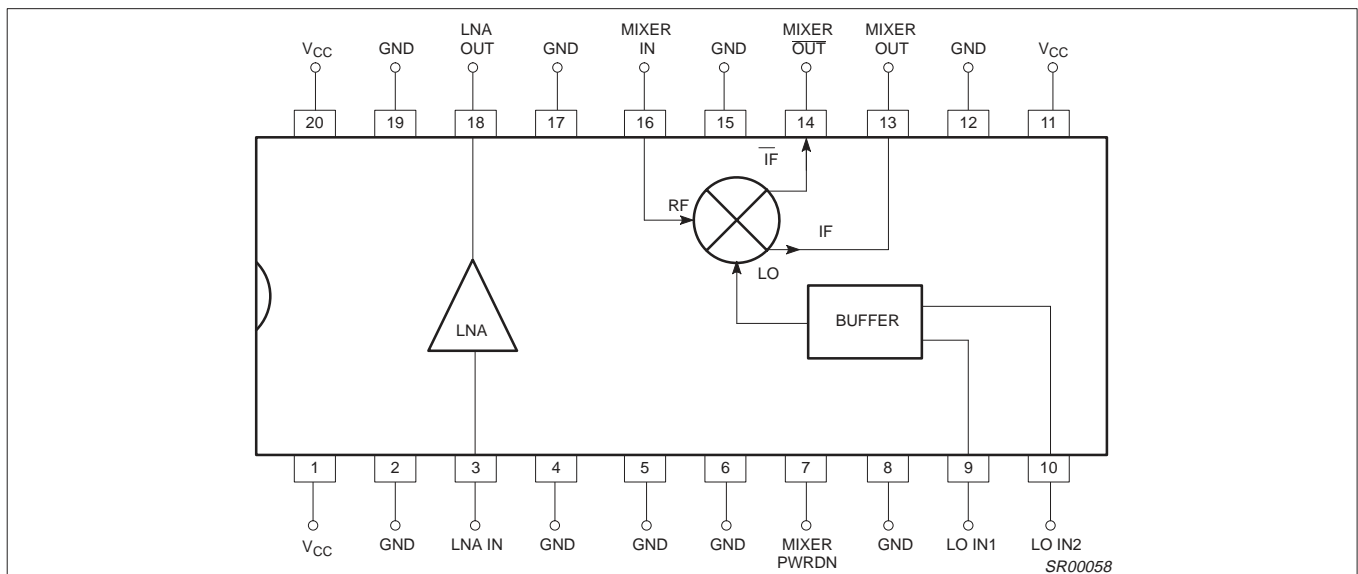


Figure 2. Block Diagram

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ABSOLUTE MAXIMUM RATINGS³

| 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
- Pins 9 and 10 are sensitive to electrostatic discharge (ESD).

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 | $^\circ\text{C}$ |
| T_J | Operating junction temperature | -40 to +105 | $^\circ\text{C}$ |

DC ELECTRICAL CHARACTERISTICS

$V_{CC} = +3\text{V}$, $T_A = 25^\circ\text{C}$; unless otherwise stated.

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | UNITS |
|---------------|-----------------------------|----------------------------|--------|------|-----|-------|
| | | | MIN | TYP | MAX | |
| I_{CC} | Supply current | | | 7.4 | | mA |
| | | Mixer power-down input low | | 4.4 | | |
| V_{LNA-IN} | LNA input bias voltage | | | 0.78 | | V |
| $V_{LNA-OUT}$ | LNA output bias voltage | | | 2.1 | | V |
| V_{MX-IN} | Mixer RF input bias voltage | | | 0.94 | | V |

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AC ELECTRICAL CHARACTERISTICS

$V_{CC} = +3V$, $T_A = 25^{\circ}C$; $LO_{IN} = -7dBm$ @ 964MHz; unless otherwise stated.

| SYMBOL | PARAMETER | TEST CONDITIONS | LIMITS | | | UNITS |
|--------------------------|---|--|-------------|-------|-------------|-----------------|
| | | | -3 σ | TYP | +3 σ | |
| S_{21} | Amplifier gain | 881MHz | 10 | 11.5 | 13 | dB |
| $\Delta S_{21}/\Delta T$ | Gain temperature sensitivity | 881MHz | | 0.003 | | dB/ $^{\circ}C$ |
| $\Delta S_{21}/\Delta f$ | Gain frequency variation | 800MHz - 1.2GHz | | 0.01 | | dB/MHz |
| S_{12} | Amplifier reverse isolation | 881MHz | | -20 | | dB |
| S_{11} | Amplifier input match ¹ | 881MHz | | -10 | | dB |
| S_{22} | Amplifier output match ¹ | 881MHz | | -10 | | dB |
| P_{-1dB} | Amplifier input 1dB gain compression | 881MHz | | -16 | | dBm |
| IP3 | Amplifier input third order intercept | $f_2 - f_1 = 25kHz$, 881MHz | -3.5 | -2 | -0.5 | dBm |
| NF | Amplifier noise figure | 881MHz | 1.3 | 1.6 | 1.9 | dB |
| VG_C | Mixer voltage conversion gain: $R_P = R_L = 1k\Omega$ | $f_S = 881MHz$, $f_{LO} = 964MHz$, $f_{IF} = 83MHz$ | 18.0 | 19.5 | 21.0 | dB |
| PG_C | Mixer power conversion gain: $R_P = R_L = 1k\Omega$ | $f_S = 881MHz$, $f_{LO} = 964MHz$, $f_{IF} = 83MHz$ | 5.0 | 6.5 | 8.0 | dB |
| S_{11M} | Mixer input match ¹ | 881MHz | | -10 | | dB |
| NF_M | Mixer SSB noise figure | 881MHz | 8.0 | 9.5 | 11.0 | dB |
| P_{-1dB} | Mixer input 1dB gain compression | 881MHz | | -13 | | dBm |
| IP3M | Mixer input third order intercept | $f_2 - f_1 = 25kHz$, 881MHz | -3.5 | -2 | -0.5 | dBm |
| IP2INT | Mixer input second order intercept | 881MHz | | 12 | | dBm |
| P_{RFM-IF} | Mixer RF feedthrough | 881MHz | | -7 | | dB |
| P_{LO-IF} | LO feedthrough to IF | 881MHz | | -25 | | dB |
| P_{LO-RFM} | LO to mixer input feedthrough | 881MHz | | -38 | | dB |
| P_{LO-RF} | LO to LNA input feedthrough | 881MHz | | -40 | | dB |
| $P_{LNA-RFM}$ | LNA output to mixer input | 881MHz | | -40 | | dB |
| P_{RFM-LO} | Mixer input to LO feedthrough | 881MHz | | -23 | | dB |
| LO_{IN} | LO drive level | 964MHz | | -7 | | dBm |

NOTE:

1. Simple L/C elements are needed to achieve specified return loss.

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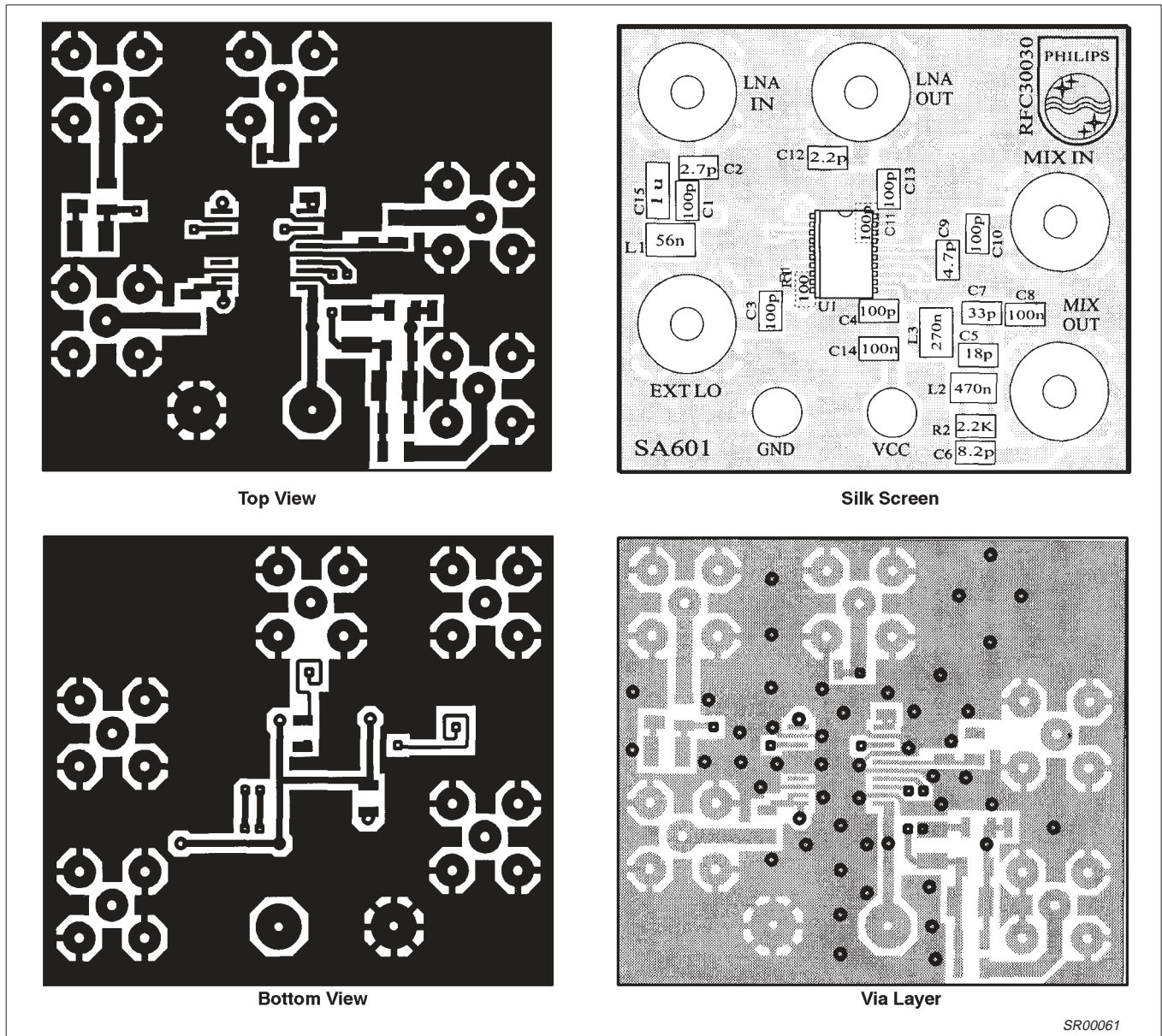


Figure 4. SA601 Demoboard Layout (Not Actual Size)

SR00061

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TYPICAL PERFORMANCE CHARACTERISTICS

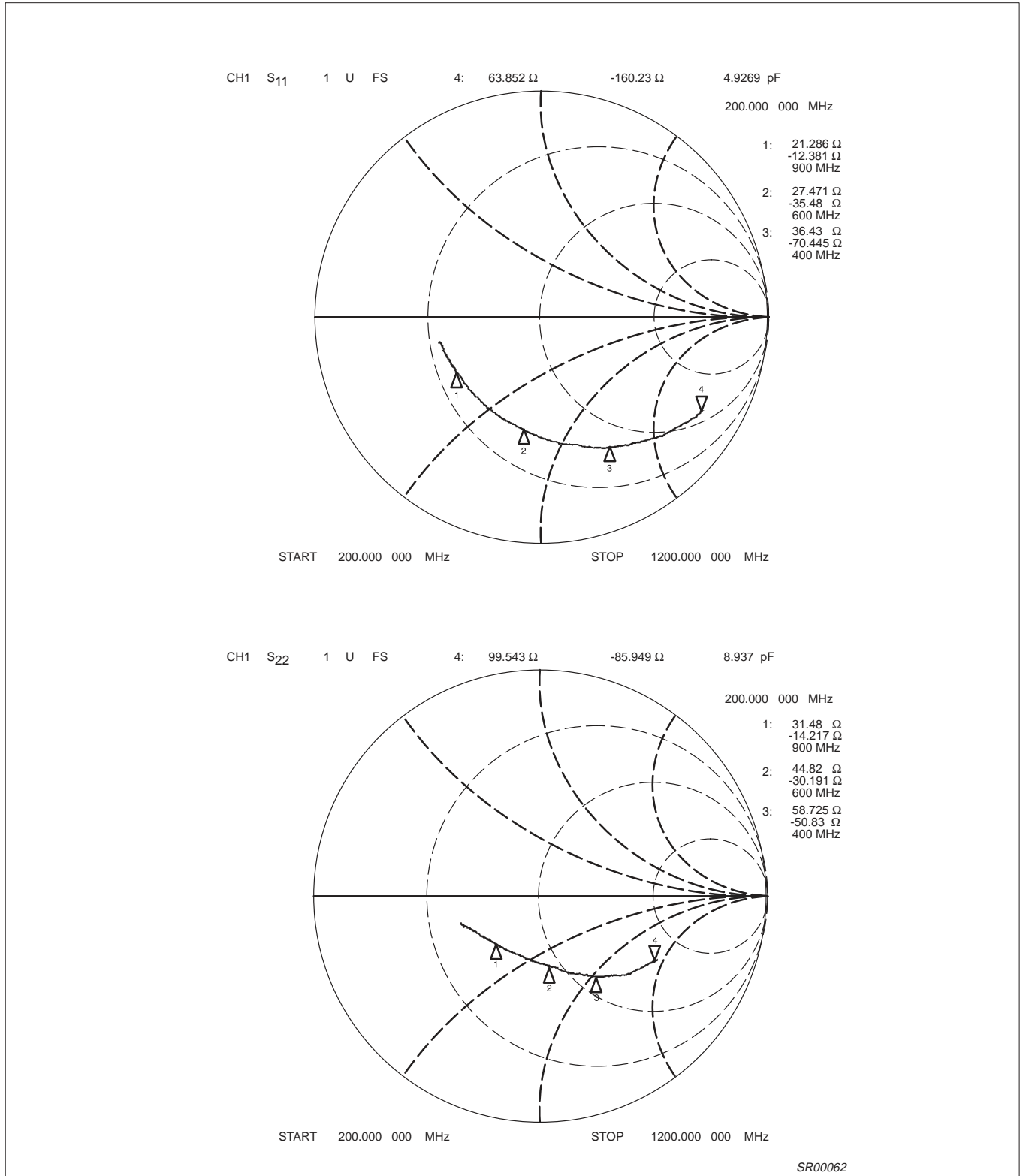


Figure 5. LNA Input and Output Match (at Device Pin)

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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

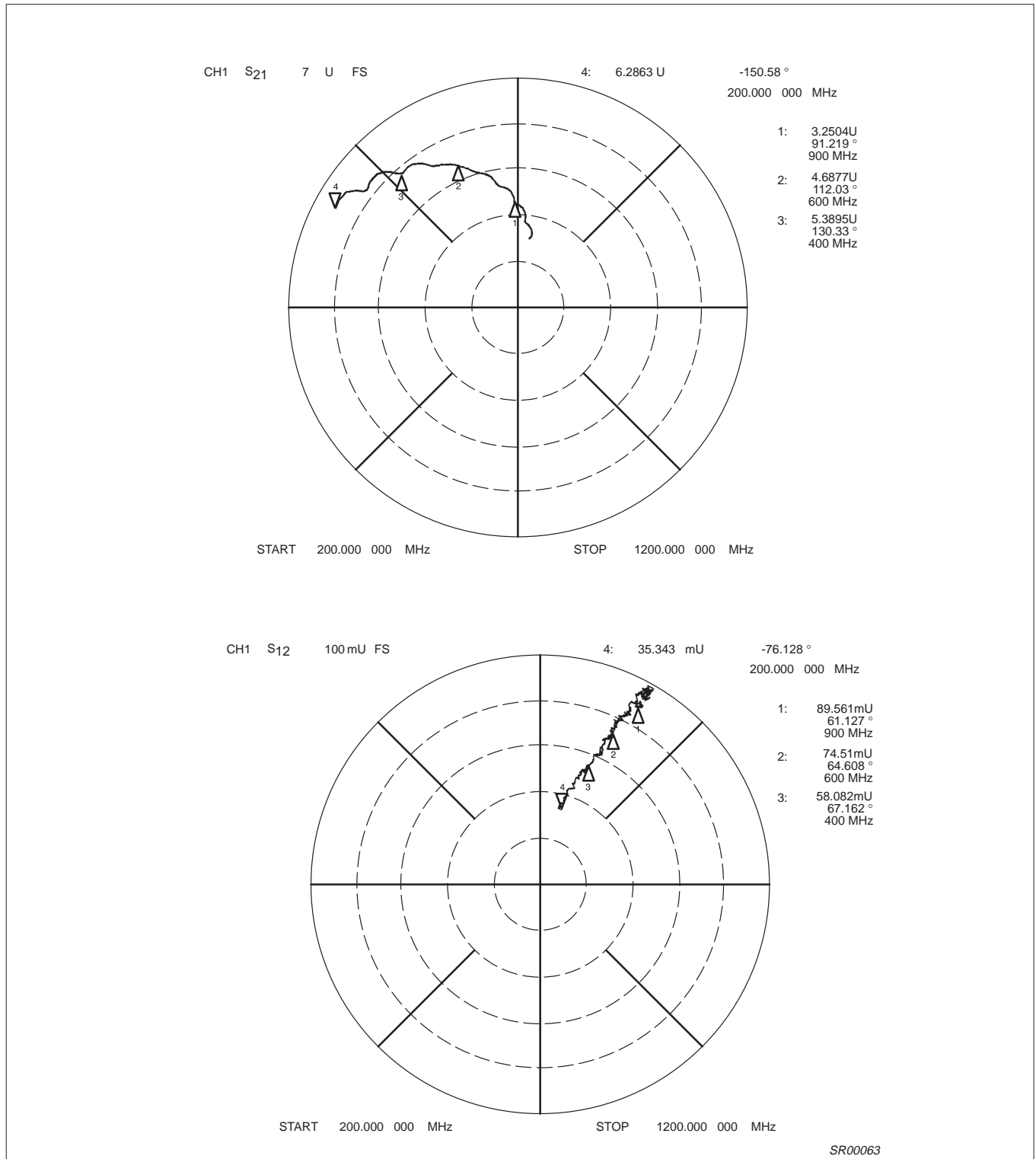


Figure 6. LNA Transmission and Isolation Characteristics (at Device Pin)

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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

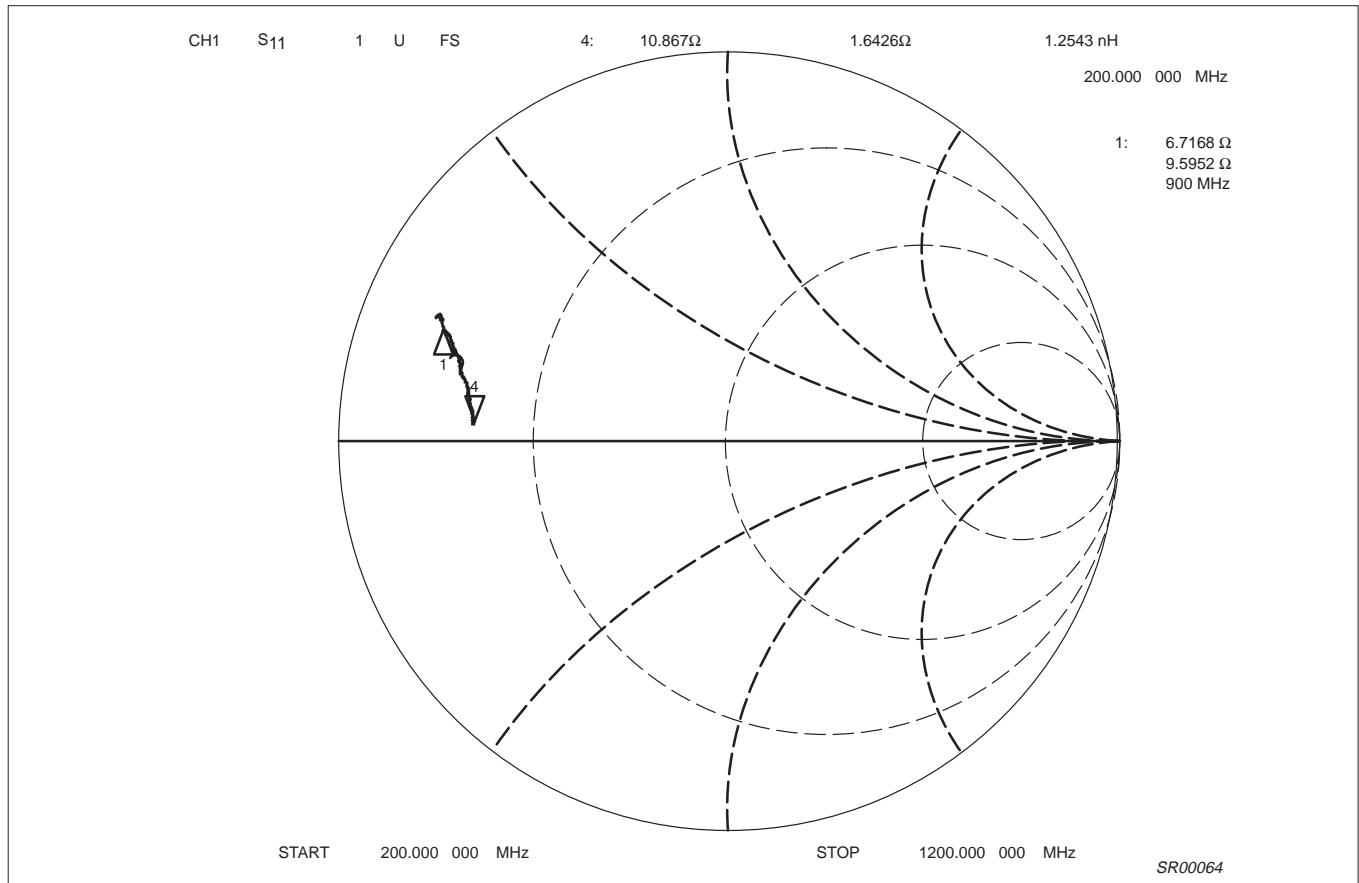


Figure 7. Mixer RF Input Match (at Device Pin)

Table 1. Typical LNA and Mixer S-Parameters

| f | LNA | | | | Mixer |
|---------|---------------------|---------------------|-------------------|--------------------|---------------------|
| | S ₁₁ | S ₂₂ | S ₂₁ | S ₁₂ | S ₁₁ |
| 200MHz | 63.852Ω - j 160.23Ω | 99.543Ω - j 85.949Ω | 6.2863U ∠ 150.58° | 35.343mU ∠ 76.128° | 10.867Ω + j 1.6426Ω |
| 300MHz | 44.879Ω - j 101.69Ω | 73.387Ω - j 67.707Ω | 5.8096U ∠ 140.47° | 47.946mU ∠ 71.169° | 10.4Ω + j 3.4609Ω |
| 400MHz | 36.43Ω - j 70.445Ω | 58.725Ω - j 50.83Ω | 5.3895U ∠ 130.33° | 58.082mU ∠ 67.162° | 10.067Ω + j 4.897Ω |
| 500MHz | 30.395Ω - j 48.393Ω | 49.928Ω - j 38.813Ω | 5.0428U ∠ 120.5° | 66.44mU ∠ 66.388° | 9.394Ω + j 6.0142Ω |
| 600MHz | 27.471Ω - j 35.48Ω | 44.82Ω - j 30.191Ω | 4.6877U ∠ 112.03° | 74.51mU ∠ 64.608° | 8.8945Ω + j 7.2227Ω |
| 700MHz | 24.428Ω - j 25Ω | 39.268Ω - j 24.502Ω | 4.2409U ∠ 104.44° | 82.235mU ∠ 65.002° | 8.1353Ω + j 8.1597Ω |
| 800MHz | 22.434Ω - j 17.255Ω | 34.664Ω - j 18.59Ω | 3.7491U ∠ 97.765° | 86.582mU ∠ 62.743° | 7.976Ω + j 9.1958Ω |
| 900MHz | 21.286Ω - j 12.381Ω | 31.48Ω - j 14.217Ω | 3.2504U ∠ 91.219° | 89.561mU ∠ 61.127° | 6.7168Ω + j 9.5952Ω |
| 1000MHz | 20.261Ω - j 8.7109Ω | 27.887Ω - j 10.77Ω | 2.8785U ∠ 84.957° | 95.135mU ∠ 60.539° | 6.2393Ω + j 10.271Ω |
| 1100MHz | 19.718Ω - j 6.252Ω | 25.741Ω - j 8.2607Ω | 2.5752U ∠ 82.893° | 97.348mU ∠ 62.202° | 6.0791Ω + j 10.571Ω |
| 1200MHz | 19.101Ω - j 4.9316Ω | 23.584Ω - j 6.2715Ω | 2.1386U ∠ 80.257° | 96.558mU ∠ 61.563° | 5.8185Ω + j 10.288Ω |

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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

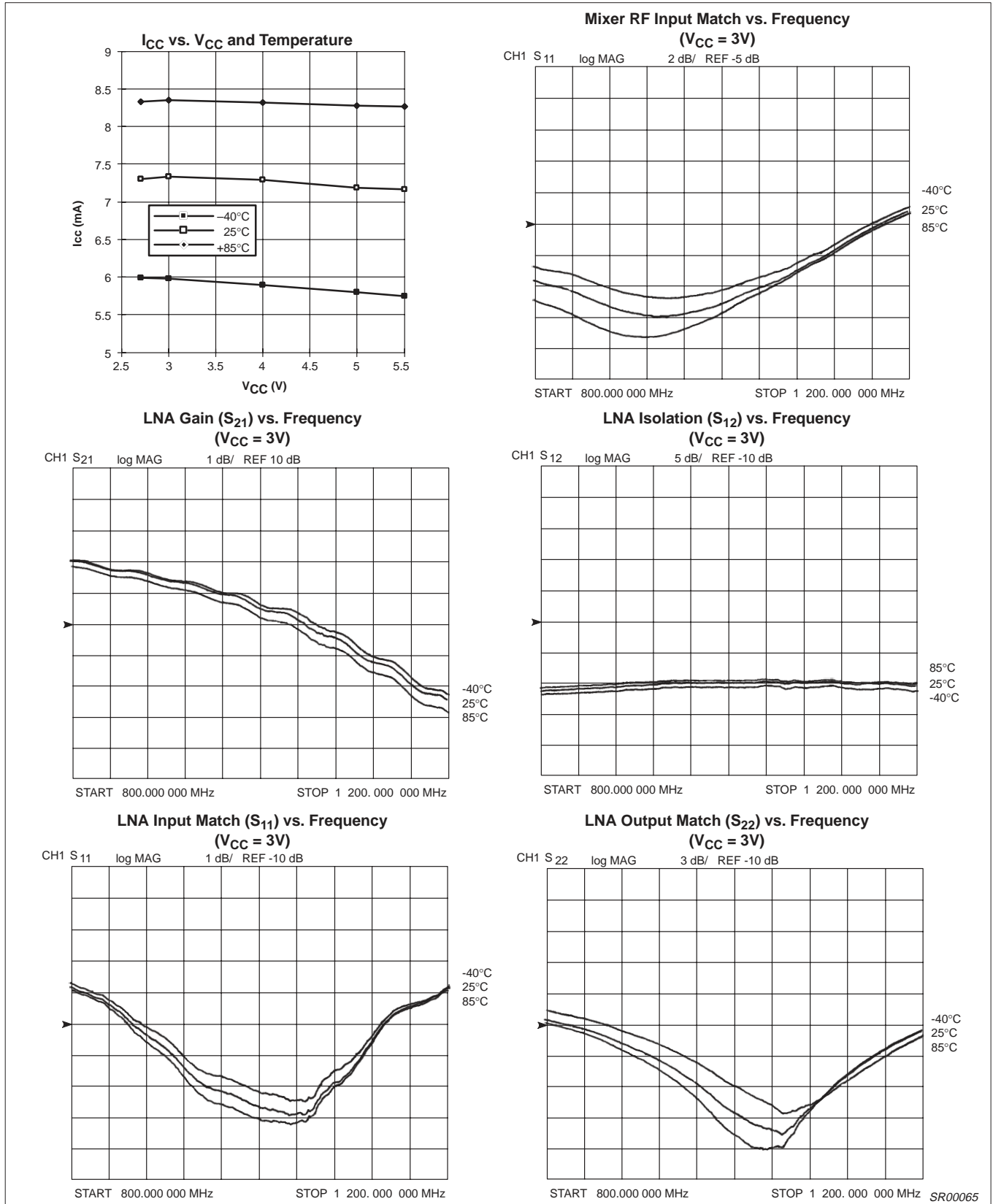


Figure 8. Typical Performance Characteristics (cont.)

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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

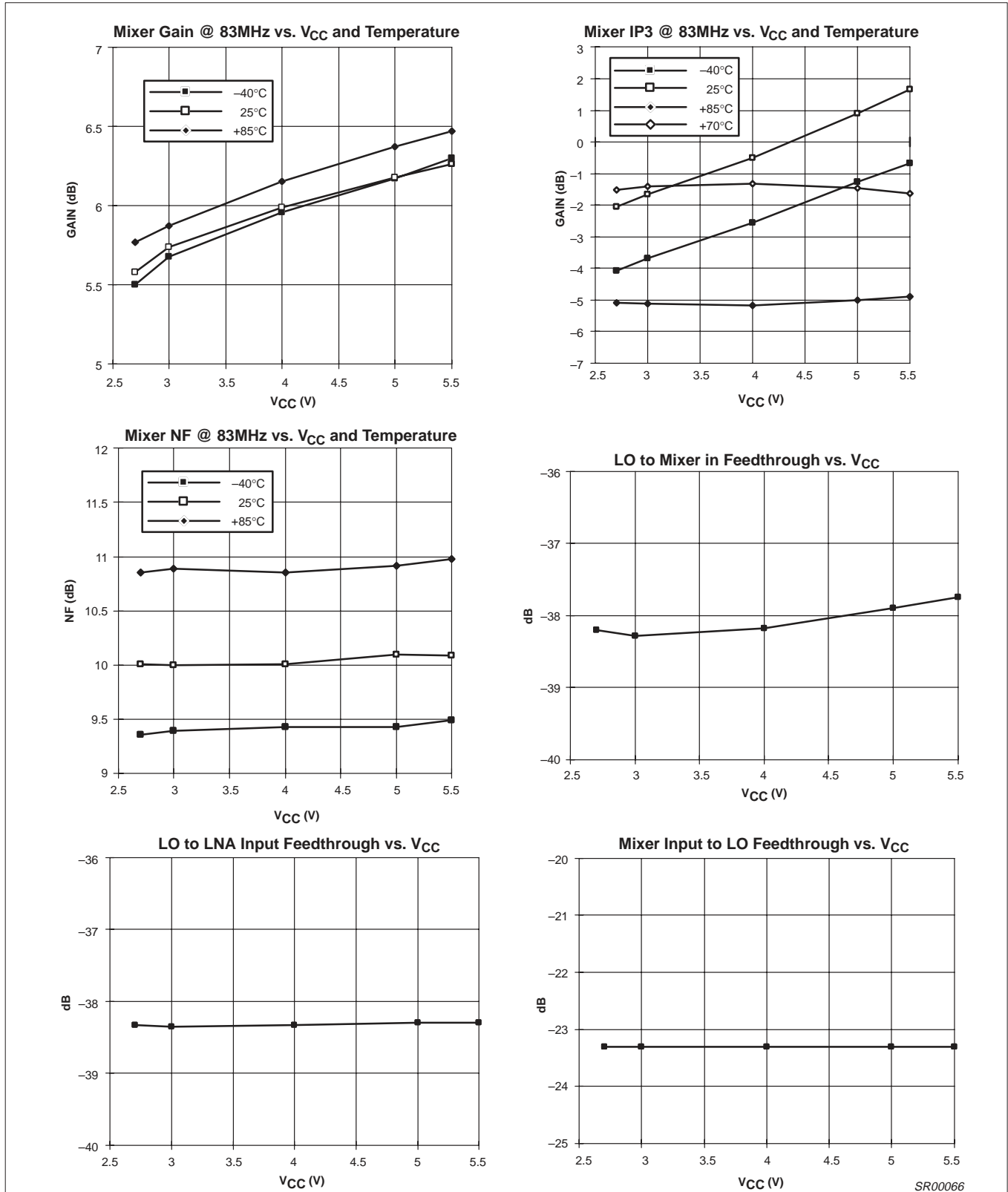


Figure 9. Typical Performance Characteristics (cont.)

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TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

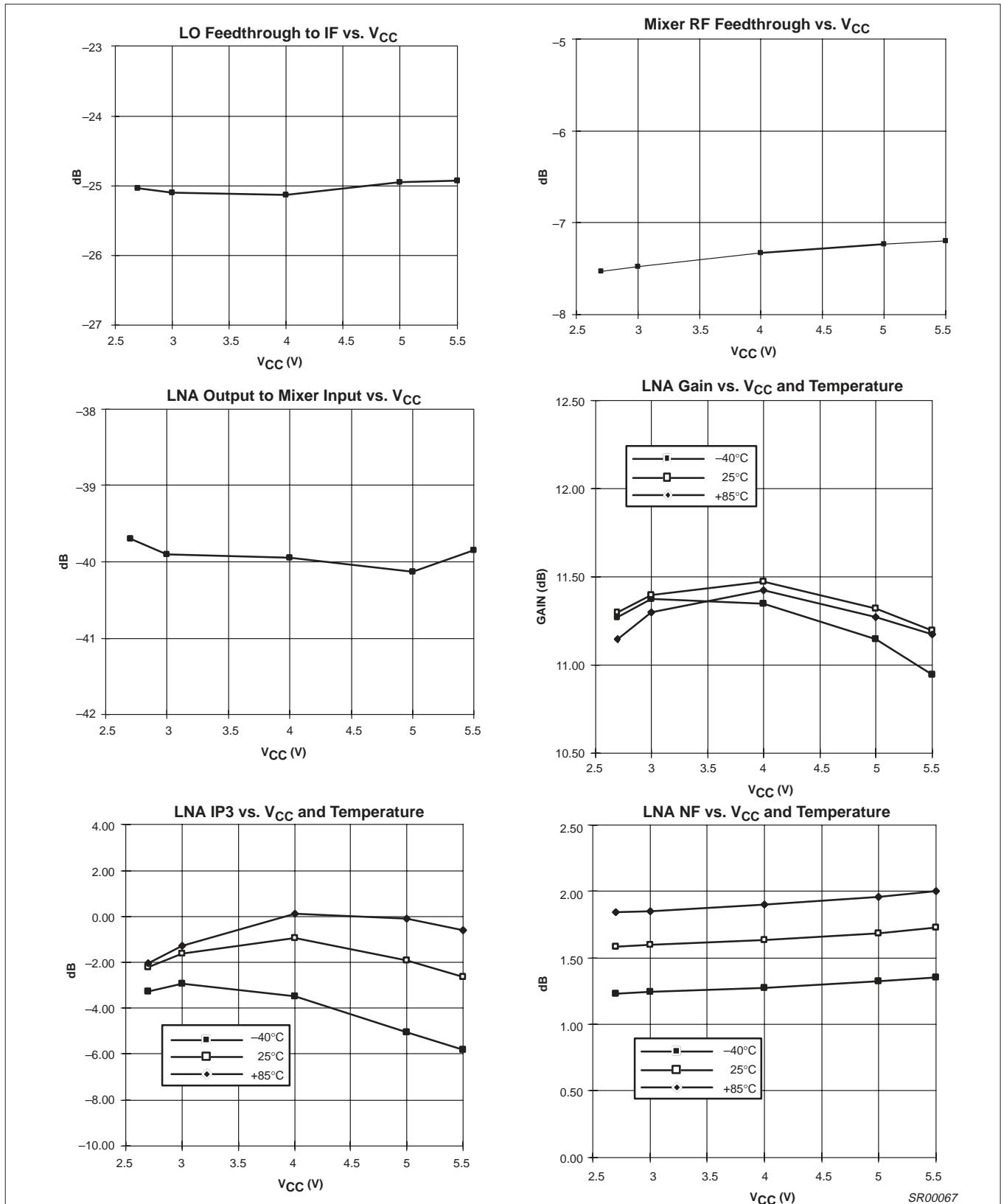


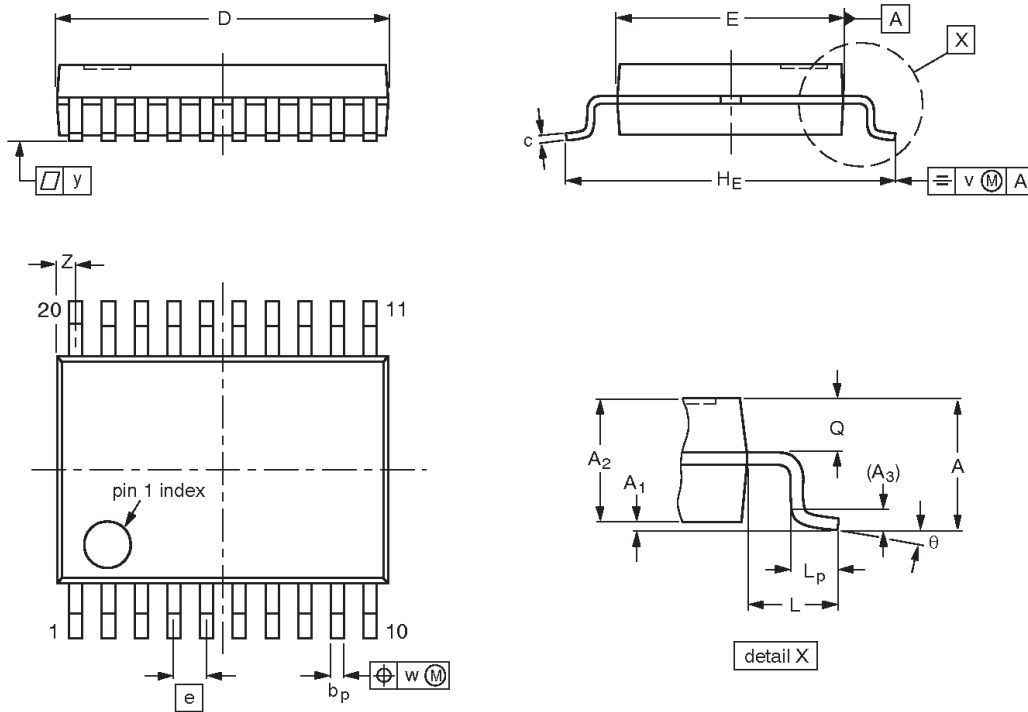
Figure 10. Typical Performance Characteristics (cont.)

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SSOP20: plastic shrink small outline package; 20 leads; body width 4.4 mm

SOT266-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽¹⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|--------------|------------------|------------------|------|----------------|---|----------------|--------------|-----|------|-----|------------------|-----------|
| mm | 1.5 | 0.15 0 | 1.4 1.2 | 0.25 | 0.32 0.20 | 0.20 0.13 | 6.6 6.4 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1 | 0.75 0.45 | 0.65 0.45 | 0.2 | 0.13 | 0.1 | 0.48 0.18 | 10° 0° |

Note

1. Plastic or metal protrusions of 0.20 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|-------|--|---------------------|----------------------|
| | IEC | JEDEC | JEITA | | | |
| SOT266-1 | | MO-152 | | | | 99-12-27 03-02-19 |

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REVISION HISTORY

| Rev | Date | Description |
|-----|----------|--|
| _2 | 20041214 | Product data (9397 750 14447); supersedes SA601 of 15 Dec 1994. Modifications: <ul style="list-style-type: none">• Added package outline and legal information |
| _1 | 19941215 | Product specification |

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Data sheet status

| Level | Data sheet status ^[1] | Product status ^{[2] [3]} | Definitions |
|-------|----------------------------------|-----------------------------------|--|
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