

MOTOROLA SEMICONDUCTOR TECHNICAL DATA

2

2N6304 2N6305

The RF Line

NPN SILICON HIGH-FREQUENCY TRANSISTORS

... designed for use as low-noise, high-gain, general-purpose amplifiers.

- High Current-Gain – Bandwidth Product –
 $f_T = 1.4 \text{ GHz (Min) @ } I_C = 10 \text{ mAdc} - 2N6304$
 $= 1.2 \text{ GHz (Min) @ } I_C = 10 \text{ mAdc} - 2N6305$
- Low Noise Figure –
 $NF = 4.5 \text{ dB (Max) @ } f = 450 \text{ MHz} - 2N6304$
 $= 5.5 \text{ dB (Max) @ } f = 450 \text{ MHz} - 2N6305$
- High Power Gain –
 $G_{pe} = 15 \text{ dB (Min) @ } f = 450 \text{ MHz} - 2N6304$
 $= 12 \text{ dB (Min) @ } f = 450 \text{ MHz} - 2N6305$

1.4 GHz @ 10 mAdc – 2N6304
1.2 GHz @ 10 mAdc – 2N6305

**HIGH FREQUENCY
TRANSISTORS**
NPN SILICON

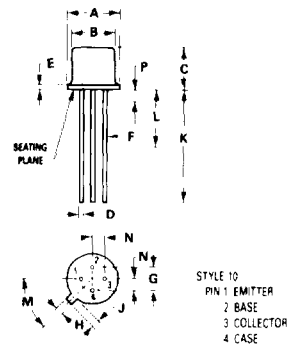
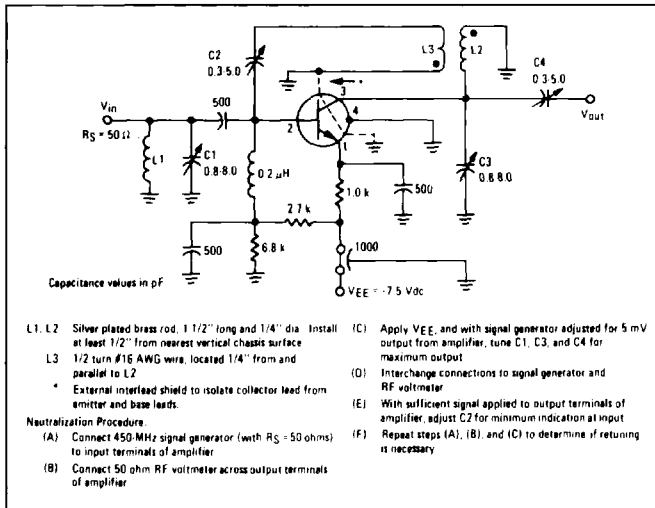


*MAXIMUM RATINGS

| Rating | Symbol | Value | Unit |
|--|-----------|-------------|----------------------------|
| Collector-Emitter Voltage 1.0 to 20 mAdc | V_{CE0} | 15 | Vdc |
| Collector-Base Voltage | V_{CB0} | 30 | Vdc |
| Emitter-Base Voltage | V_{EB0} | 3.0 | Vdc |
| Collector Current – Continuous | I_C | 50 | mAdc |
| Total Continuous Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C | P_D | 200 1.14 | mW mW/ $^\circ\text{C}$ |
| Storage Temperature Range | T_{stg} | -65 to +200 | $^\circ\text{C}$ |

*Indicates JEDEC Registered Data.

FIGURE 1 – TEST CIRCUIT FOR NOISE FIGURE AND POWER GAIN



| DIM | MILLIMETERS | | INCHES | |
|-----|--------------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 5.31 | 5.84 | 0.209 | 0.230 |
| B | 4.52 | 4.95 | 0.178 | 0.195 |
| C | 4.32 | 5.33 | 0.170 | 0.210 |
| D | 0.41 | 0.53 | 0.016 | 0.021 |
| E | — | 0.76 | — | 0.030 |
| F | 0.41 | 0.48 | 0.016 | 0.019 |
| G | 2.54 BSC 0.100 BSC | | | |
| H | 0.91 | 1.17 | 0.036 | 0.046 |
| J | 0.71 | 1.22 | 0.028 | 0.048 |
| K | 12.70 | — | 0.500 | — |
| L | 6.35 | — | 0.250 | — |
| M | 45° BSC | | 45° BSC | |
| N | 1.27 BSC | | 0.050 BSC | |
| P | — | 1.27 | — | 0.050 |

**CASE 20-03
TO-206AF
(TO-72)**

2N6304, 2N6305

*ELECTRICAL CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic | Symbol | Min | Typ | Max | Unit |
|--|---------------|-----|-----|-----|------|
| OFF CHARACTERISTICS | | | | | |
| Collector-Emitter Breakdown Voltage ($I_C = 5.0 \text{ mAdc}, I_B = 0$) | $V_{(BR)CEO}$ | 15 | — | — | Vdc |
| Collector-Base Breakdown Voltage ($I_C = 0.1 \text{ mAdc}, I_E = 0$) | $V_{(BR)CBO}$ | 30 | — | — | Vdc |
| Emitter-Base Breakdown Voltage ($I_E = 0.1 \text{ mAdc}, I_C = 0$) | $V_{(BR)EBO}$ | 3.5 | — | — | Vdc |
| Collector Cutoff Current ($V_{CB} = 5.0 \text{ Vdc}, I_E = 0$) | I_{CBO} | — | — | 10 | nAdc |

ON CHARACTERISTICS

| | | | | | |
|---|----------|----|---|-----|---|
| DC Current Gain ($I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}$) | h_{FE} | 25 | — | 250 | — |
|---|----------|----|---|-----|---|

DYNAMIC CHARACTERISTICS

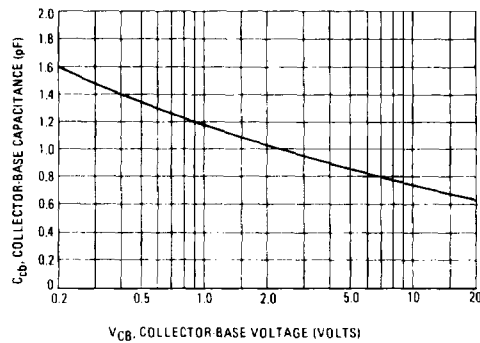
| | | | | | | |
|--|------------------|------------|--------------|--------|------------|-----|
| Current-Gain-Bandwidth Product ($I_C = 10 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 100 \text{ MHz}$) | 2N6304 2N6305 | f_T | 1400 1200 | — — | — — | MHz |
| Collector-Base Capacitance ($V_{CB} = 10 \text{ Vdc}, I_E = 0, f = 1.0 \text{ MHz}$) | | C_{cb} | — | 0.8 | 1.0 | pF |
| Small-Signal Current Gain ($I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 1.0 \text{ kHz}$) | | h_{fe} | 25 | — | 250 | — |
| Collector-Base Time Constant ($I_E = 2.0 \text{ mAdc}, V_{CB} = 5.0 \text{ Vdc}, f = 31.8 \text{ MHz}$) | 2N6304 2N6305 | $r_b' C_c$ | 2.0 2.0 | — — | 12 15 | ps |
| Noise Figure ($I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, R_S = 50 \text{ ohms}, f = 450 \text{ MHz}$) (Figure 1) | 2N6304 2N6305 | NF | — — | — — | 4.5 5.5 | dB |

FUNCTIONAL TEST

| | | | | | | |
|--|------------------|----------|----------|--------|--------|----|
| Common-Emitter Amplifier Power Gain ($I_C = 2.0 \text{ mAdc}, V_{CE} = 5.0 \text{ Vdc}, f = 450 \text{ MHz}$) (Figure 1) | 2N6304 2N6305 | G_{pe} | 15 12 | — — | — — | dB |
|--|------------------|----------|----------|--------|--------|----|

*Indicates JEDEC Registered Data.

**FIGURE 2 — COLLECTOR-BASE CAPACITANCE
versus COLLECTOR BASE VOLTAGE**



2N6304, 2N6305

2

FIGURE 3 - CURRENT-GAIN-BANDWIDTH PRODUCT versus COLLECTOR CURRENT

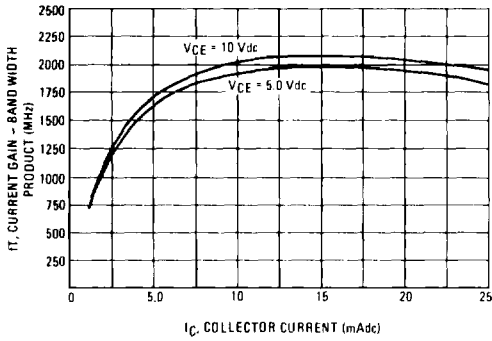


FIGURE 4 - COLLECTOR-BASE TIME CONSTANT versus EMITTER CURRENT

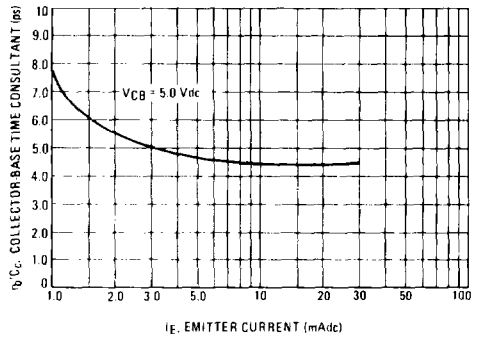


FIGURE 5 - REVERSE TRANSFER ADMITTANCE versus FREQUENCY

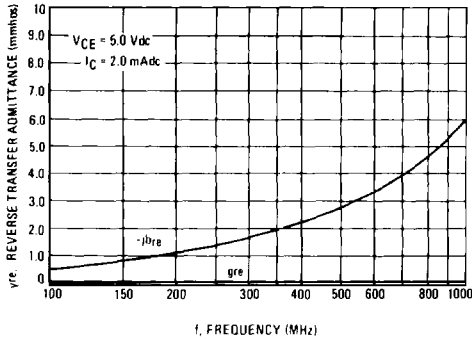


FIGURE 6 - INPUT ADMITTANCE versus FREQUENCY

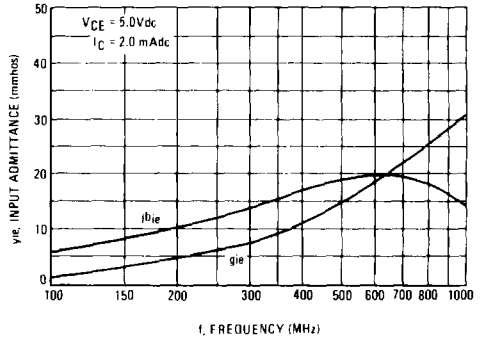


FIGURE 7 - OUTPUT ADMITTANCE versus FREQUENCY

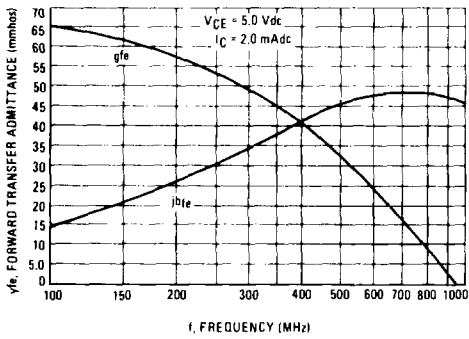


FIGURE 8 - FORWARD TRANSFER ADMITTANCE versus FREQUENCY

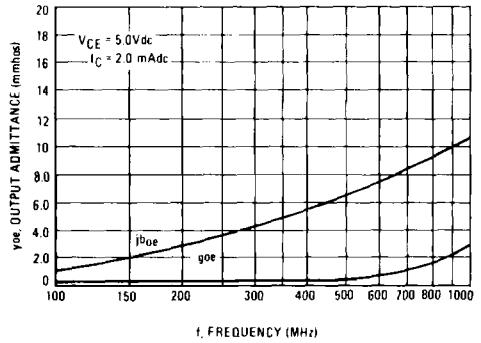


FIGURE 9 - S_{11} , INPUT REFLECTION COEFFICIENT

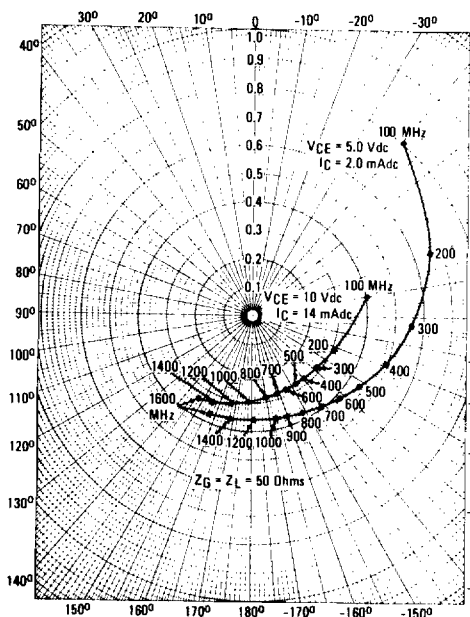


FIGURE 10 - S_{22} , OUTPUT REFLECTION COEFFICIENT

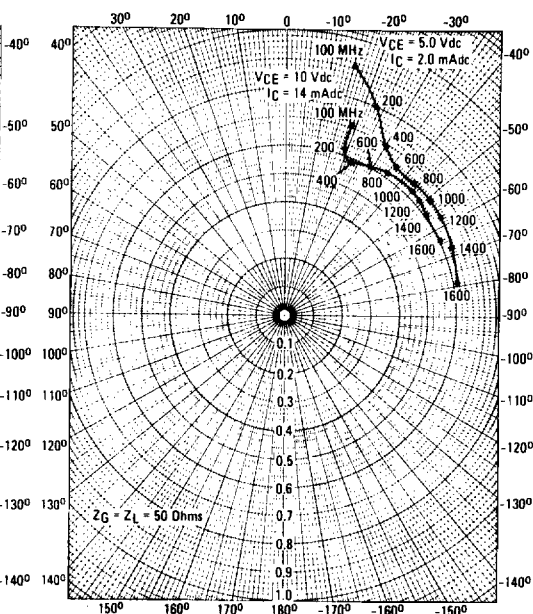


FIGURE 11 - S_{12} , REVERSE TRANSMISSION COEFFICIENT

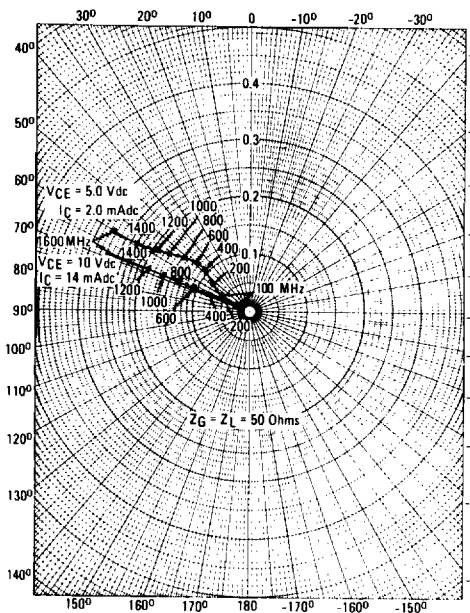
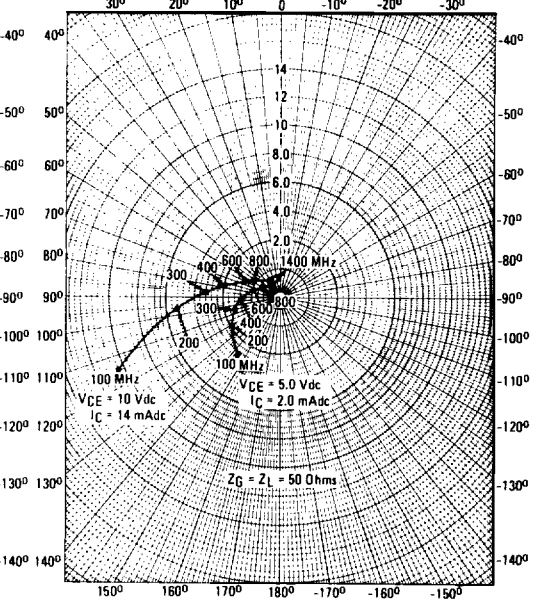


FIGURE 12 - S_{21} , FORWARD TRANSMISSION COEFFICIENT



2

2N6304, 2N6305

FIGURE 13 - S₁₁, INPUT REFLECTION COEFFICIENT AND S₂₂, OUTPUT REFLECTION COEFFICIENT

